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TOOTHBRUSHES, TOOTHBRUSH MATERIALS AND DESIGN

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In recent years, the dental profession, government agencies and the public have exhibited a markedly increased interest in toothbrushes. This aroused attitude has developed in response to a long-felt need for authentic knowledge concerning the toothbrush, its object, its requisite physical characteristics and its proper design. Several factors have contributed toward this interest, among them being the extensive use of synthetic filament in lieu of natural bristles, divergent variations in pattern and conflicting advertising claims. Also, greatly increased wartime purchases by the Red Cross, the War and the Navy Departments and other public agencies have focused attention on possible deficiencies in existing standards for toothbrushes, particularly in respect to design. It is the purpose of this study to review the evolutionary background of the toothbrush, its purpose and its requirements; to analyze the merits of various materials of construction, and to present the views of competent authorities on proper design.

History of the Toothbrush

Although tooth cleaning devices of one sort or other have probably been used throughout human history, the toothbrush as it is known today does not appear to have come into being until comparatively modern times. The earliest known record is found in the Chinese literature of about 1600, but materials and construction are not described.[1] The origin of the device in Europe is confused; yet available evidence[2, 3, 4, 5] would indicate that in Western civilization the toothbrush is perhaps no older than two

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1. Bodecker, H. W. C.: The Physiologically Clean Mouth. D. Cosmos 68:425, May 1926.
2. Kanner, Leo: Folklore and Cultural History of the Toothpick and Toothbrush. D. Cosmos 68:691, July 1926.
3. Thomas, C. E.: Story of the Toothbrush. D. Digest 30:602, August 1924.
4. Asgis, A. J.: History of the Toothbrush and Hair-Bristle Toothbrush. D. Digest 35:307, May 1929.
5. Addis, Robert: History of the Toothbrush. Brit. D. J. 66:532, May 1, 1939.

or three hundred years. Fauchard[6] (1678-1761), in his famous treatise on dentistry, criticized toothbrushes, then in vogue, and advocated wet sponges or specially prepared herb roots in their stead. There is some indication that early toothbrushes were expensive novelties in the nature of a mop of textile material and little resembled those of today. In this connection, it is of interest that no illustration of a toothbrush dated prior to 1818 has been reported.[2]

According to Addis,[5] the first toothbrush resembling the modern article was made by William Addis of Clerkenwall, England, in 1780. This instrument consisted of a bone handle and natural bristles drawn into holes bored into the head and secured by wires. Production was continued by William Addis and taken up by others, so that, by 1840, toothbrushes were being made in England, France and Germany. During the latter part of the nineteenth century, Japan and the United States entered the field. The first American toothbrush patent was that of H. N. Wadsworth, in 1857.

With the exception of variations in size and trim, no departure from the original manufacture occurred until the early part of the present century, when celluloid handles were developed. Change from natural to synthetic materials was completed by the substitution of plastic bristles for hog bristles during the last seven years. This alteration took place largely because of advantages inherent in the use of a synthetic product, although it was encouraged and accelerated by an acute shortage of natural bristles occasioned by difficulties of supply and the unprecedented demand for brushes during the war. The use of synthetic materials has been accepted by manufacturers, the public and the dental profession; but incomplete satisfaction with plastic bristling, particularly within the profession, may indicate desirable properties of animal bristles not obtainable at this time in synthetic filament.

Significantly, the toothbrush evolved into its many forms through promotional effort and selective consideration of functional factors. This fact reflects the arbitrary nature of toothbrush design and is an underlying cause for the problems presently connected with it.

Recent Statistics

Data (Table 1) released by the War Production Board indicate that 185.3 million toothbrushes, including dental plate brushes, were shipped from factories in 1944. Of this number, 78.8 million (43 per cent) were distributed to the military, post exchanges, ships' stores, Red Cross and export agencies, leaving 106.5 million for the domestic civilian market. More than 80 per cent were currently being bristled with nylon filament, and the sale of synthetic brushes was three times that of 1941, the first full year of their manufacture. Total civilian shipments represented a substantial increase over the 70 million sold in 1939, the last normal peacetime year; but since approximately 220 million would be required to supply with two brushes yearly each person who is more than 2 and less than 60 years of age in the United States, it is evident that, even in the flush of wartime prosperity, the majority of Americans do not use toothbrushes.

Growth in the dollar value[7] of toothbrushes produced in the United States in the decade preceding World War II, and an estimate of production for 1946, selected as the first postwar year of full employment, are indicated in Table 2. Increasing American production is significant in view of the fact that at one

6. Viau, George: Life of Pierre Fauchard. D. Cosmos 65:797, August 1923.

7. Killam, E. R.: Brushes in the Postwar Period. Domestic Commerce 32:15, November 1944.

Table 1.—Toothbrushes: United States Manufacturers' Shipments*

Year	Market	Millions of Units			Total†	Per Cent
		Natural Bristle	Nylon	Patent Fiber and Mixtures		
1939	Domestic	56.0	14.0	--	70.0	100
1942	Domestic	24.0	70.8	12.4	107.2	86
	Military and Red Cross	---	14.8	--	14.8	12
	Export	--	2.0	--	2.0	2
	Total	24.0	87.6	12.4	124.0	100
	Per cent	19	71	10	100	--
1943	Domestic	8.8	76.4	28.2	113.4	70
	Military and Red Cross	0.5	38.2	0.6	39.3	24
	Export	2.0	5.2	2.1	9.3	6
	Total	11.3	119.8	30.9	162.0	100
	Per cent	7	74	19	100	--
1944	Domestic	6.5	76.6	23.4	106.5	57
	Military and Red Cross	0.1	59.1	0.1	59.3	32
	Export	1.2	14.6	3.7	19.5	11
	Total	7.8	150.3	27.2	185.3	100
	Per cent	4	81	15	100	--
1945 (First six months)	Domestic	5.4	37.9	8.0	51.4	51
	Military and Red Cross	0.04	38.2	0.02	38.3	38
	Export	0.7	7.3	3.6	11.5	11
	Total	6.1	83.4	11.6	101.1	100
	Per cent	6	83	11	100	--

*Compiled from statistics released by the War Production Board, Textile Clothing and Leather Bureau. (Figures for the intervening years are not available.)
†Includes dental plate brushes, 2.5 million of 1944 shipments consisting of this item.

time Japan supplied more than 90 per cent of the toothbrushes sold in this country. Since 1929, when the number imported about equalled the number produced domestically, imports have decreased, until by 1940 they were about 10 per cent of domestic production. None have been imported since 1941.

Professional Opinion

Generally, the dental profession appears to have been content to allow the toothbrush to develop at random. For more than fifty years, individual dentists, editors and laymen, with little or no attempt at concerted effort, advanced new designs, suggested improvements, advocated, criticized, condemned and belligerently tolerated the toothbrush. The resulting confusion and lack of progress in the field of oral hygiene prompted Talbot[8] in 1910 to censure an untenable situation in which the "market (was) full of all sizes and shapes of handles and bristles . . . bought regardless of their adaptability to the mouth and teeth. . . ." Nevertheless, it should not be inferred that the problem has been entirely ignored by organized dentistry.

In 1919, a committee of the American Academy of Periodontology prepared a report[9] setting forth specifications for toothbrushes for adults, children more than 3 years of age and children less than 3 years of age. These brushes were characterized chiefly by a linear gradient in the lengths of the tufts descending from shank to extremity, presumably to facilitate access to the buccal surfaces of the maxillary molar teeth. The handle, shank and head were alined on the same axis.

Toothbrushes advocated by the Academy's committee apparently never won widespread recognition by the profession at large, but the action of the committee did serve to attract attention to the

8. Talbot, E. S.: Oral Hygiene and American Dental Schools. D. Cosmos 52:647, June 1910.

9. Sarrazin, J. J.: The Toothbrush and Methods of Cleaning Teeth. J. Nat. D. A. 7:155, February 1920; Idem., D. Items Interest 42:193, March 1920.

Table 2.--Normal Toothbrush Production in the United States*

Year	Retail Value of Product in Millions of Dollars
1929	5.7
1931	5.0
1933	4.7
1935	6.1
1937	6.3
1939	7.7
1946	12.4†

*Source: Census of Manufactures, Bureau of Census, U. S. Department of Commerce.

†Statistical estimate of the Specialties Unit, Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce.

existence of a problem in toothbrush design. Subsequent studies, particularly by Kauffmann,[10] Asgis,[11] Stillman[12] and Hirschfeld,[13] demonstrated that few toothbrushes available on the market conformed to a scientific standard compatible with the requirements of oral hygiene. These studies and the development of rational procedures[14, 15] for brushing the teeth have resulted in preference for two-row and three-row brushes with a small head and with tufts of equal length.[16] Replies received in response to a questionnaire distributed in 1942 by the American Dental Association in an effort to crystallize opinion on the proper kinds and types of toothbrushes not only indicate a preferential design (Table 3) but definitely disfavor motor-driven and novel tooth-cleaning devices. Copies were mailed to ninety-two especially well-qualified individuals who were actively interested in the problem; sixty-five questionnaires were returned.

Definition and Requirements

Kauffmann[10] defines the toothbrush as an "artificial hygienic device used in conjunction with a dentifrice to brush the teeth, consisting usually of a handle and clusters of bristles so arranged as to exert the most beneficial action possible without causing injury to the hard structures or adjacent soft tissues." The functional and physical connotations of this description are consistent with fact and provide a valid foundation on which to base the construction of a rationally designed instrument. Gingival stimulation and massage, being inseparably identified with proper cleansing of the teeth, need not be considered as separate functions of the toothbrush for purposes of design.

A completely satisfactory toothbrush must be (1) suited to individual requirements in size, shape and texture, (2) light in weight, (3) easily manipulated, (4) efficient, (5) impervious to moisture, (6) easily cleaned, (7) durable, (8) inexpensive and (9) pleasing to the eye. It cannot be defined in terms of a brushing method that will not produce injury.

Materials

Selection of materials for the construction of the toothbrush requires deference to (1) the purpose of the toothbrush, (2) the conditions of usage, (3) the requisite

10. Kauffmann, J. H.: A Study of the Toothbrush. I, D. Cosmos 66:300, March 1924; II, Ibid. 71:132, February 1929; III, Ibid. 74:601, June 1932; IV, J.A.D.A. 26:32, January 1939.

11. Asgis, A. J.: Is the Toothbrush Manufacturer Guided by a Scientific Standard That Conforms to the Requirements of Oral Medicine? Am. D. Surg. 49:423, September 1929.

12. Stillman, P. R.: The Toothbrush. J. Am. D. Hygienists' A. 7:3, November 1933.

13. Hirschfeld, Isador: The Toothbrush: Its Use and Abuse. Brooklyn: Dental Items of Interest Publishing Co., Inc., 1939.

14. Charters, W. J.: Immunizing Hard and Soft Tissues to Infection by Correct Stimulation with the Toothbrush. J.A.D.A. 15:87, January 1928.

15. Stillman, P. R.: Philosophy of Treatment of Periodontal Disease. D. Digest 38:314, September 1932.

16. Hirschfeld, Isador: Why and How of Toothbrushing. J.A.D.A. 32:80, January 1, 1945.

functional properties, (4) the cost and (5) the exigencies of supply and production.

The purpose of the toothbrush is, by definition, to clean the teeth. This result is accomplished by utilization of friction between the brushing plane and the surfaces of the teeth. The efficiency with which it is accomplished depends directly on the composition, texture and form of the brushing surface, and indirectly on the rigidity and the design of the handle. Relative ability of the bristling to retain a dentifrice while in function is an important contributory factor.

The conditions under which the toothbrush is used necessitate materials able to withstand successive and alternate exposures to the destructive influences of moisture, air and sunlight, and, if feasible, to the effects of boiling water. In addition, all parts of the brush should be indestructible, i.e., unbreakable under probable conditions of use, and should have strength sufficient to transmit the forces applied to them in brushing the teeth effectively.

The functional properties of materials used in the toothbrush are those fundamentally essential to utility: optimum stiffness, flexibility, elasticity and durability in the bristles; rigidity, lightness and strength in the head, shank and handle.

The cost is a major consideration in the selection of materials, and should be as low as possible, consistent with a satisfactory product. This policy would permit maximum distribution of good toothbrushes. Brushes that are sold at unusually high prices or that are composed of inordinately expensive or unnecessary materials, unless they embody definite functional advantages not obtainable in the usual article, are at variance with this objective.

The exigencies of supply and production may determine the selection of materials by reason of availability, favorable cost and economic adaptability to established methods and instruments of production. Recent extensive substitution of nylon for natural bristling was to a large extent dictated by the difficulty of supplying the natural product, most of which came from China before the war.

Bristles

The bristles form the brushing plane and are directly responsible for the functional efficiency of the toothbrush. Only the finest quality bristling meets the exacting physical requirements: (1) stiffness sufficient to permit the application of normal brushing force (approximately 1 to 3 pounds) to the teeth, but not so great as to cause injury to the soft tissues or to preclude penetration into the interproximal embrasures or deep occlusal recesses; (2) flexibility for effective distribution of the brushing surface over tooth and gum contours and into embrasures and occlusal depressions; (3) elasticity for usefulness, and (4) durability sufficient to provide satisfactory three-times-daily service for at least a few months. Two classes of bristles are commonly used, natural and synthetic.

Natural bristles are obtained from the backs of swine. Physical properties of the product vary, depending on the breed of the animal, geographical location and season in which the bristles are taken. In general, the older the animal and the more rigorous his habitat, the higher is the quality of the product. The most satisfactory natural bristling is equivalent in diameter and texture to butt cuts (1¼ inch segments closest to the hide) of 3¼ inch or longer white stock. Butt cuts are best qualified by their stiffness, elasticity and content of natural oils, although other cuts are employed in second-grade toothbrushes. Bronze and black bristling have a color disadvantage, but are otherwise adequate. Bleaching or dyeing natural bristles tends to reduce their useful life. Both processes are

unnecessary, except as bleaching occurs in routine dressing and sterilization of the raw product. Waterproofing technics used by several manufacturers reduce the water absorbency of natural bristles.

Natural filaments vary in diameter from 0.0035 to 0.0190 of an inch and are usually oval or irregular, seldom circular, in cross-section. Bristles 0.007 to 0.010 of an inch in diameter are ideal, but represent only a portion of any dressed assortment. Hence even the finest natural bristle toothbrushes contain a quantity of filaments that are easily broken or split. Although the wearing quality of natural bristles varies tremendously, it is significant that fixed physical standards for their grading have not been found practicable.

Synthetic bristles are manufactured* from nylon, a plastic of versatile application and of great importance in industry. This type of bristling was first applied to toothbrushes in 1938. At the time that the United States entered World War II, synthetic bristles had replaced natural bristles in about 50 per cent of the toothbrushes being sold in this country. Subsequent shortage of natural bristle due to emergency conditions virtually completed the substitution by 1944 (Table 1). However, relaxation of War Production Board controls July 18, 1945, has allowed the use of hog bristles up to 3⅞ inches in length for the production of natural-bristle toothbrushes in approximately prewar quantities.

Several products are designated as nylon, each processed to meet certain physical requirements. Hence the quality of synthetic filament has varied from time to time, a fact that apparently has contributed to the conflict in opinion regarding the merits of nylon-bristled toothbrushes. Until 1942, synthetic bristles were made from so-called type 1 and type 2 nylons, but during that year wartime restrictions necessitated their manufacture from regenerated nylon flake only. Early in 1943, an improved product, type 3, was introduced and has since been employed in the bristling of all American-made synthetic toothbrushes.

Plastic bristles commonly used in toothbrushes are translucent and colorless, but can be supplied in opaque, white, black or colored filaments. Federal specifications (H-B-671a) require an undyed product with melting point no higher than 200° C., specific gravity 1.2 or less, loss of weight on heating for eight hours at 100° C. no greater than 0.3 per cent and moisture absorption at 50 per cent relative humidity and 25° C. no more than 3.0 per cent. Bristles must also show no discoloration or appreciable change in stiffness after boiling in water for five minutes and drying for three hours at 70° C. or after being exposed for twenty-four hours to ultraviolet radiation. Nylon bristling currently employed apparently absorbs less moisture than natural bristles (3.3 per cent as compared with approximately 7 per cent at 100 per cent humidity), but there is no evidence that it is endowed with greater ability to maintain its initial stiffness under relatively humid conditions, although immersion tests indicate a negligible uptake of water by type 3 nylon if previously exposed to relative humidities higher than 50 per cent.

Durability and uniformity are distinct advantages of nylon bristling. Numerous abrasion tests indicate that artificial filaments retain effective resilience at least three times as long as natural bristles of the highest quality. In fact, nylon is generally more resilient initially. The tensile strength of synthetic bristle (50,000 to 75,000 pounds per square inch) is two and one-half to three times that of the natural product (18,000 to 20,000 pounds per square inch) and the bending endurance is at least ten times as great.

*By E. I. duPont de Nemours & Company, Inc., Arlington, N. J., sole producers.

Control of the composition and the diameter of artificial filament results in a more uniform product than is obtainable in nature. By varying the diameter, or by mixing bristles of different diameters, tufts can be readily made to fit any desired stiffness requirement. Diameters commonly used vary from 0.008 to 0.015 of an inch and are numbered accordingly. Brushes bristled with numbers 8, 9 and 10 are generally considered "soft"; 11 and 12, "medium"; 13 and 14, "hard," and 15, "extra hard."* Tolerance in the diameters of individual filaments is ± 0.0005 of an inch; the cross-sections are round or very slightly oval. The smooth finish (Fig. 1) of nylon filament may render nylon bristle more easily cleaned than natural bristle, but the comparative effectiveness of nylon and natural bristle as cleansing agents has not been adequately tested.

Other tufting materials, including rubber, cotton, patent fiber, badger hair and mixtures, have been used with varying degrees of success. A relatively small proportion of toothbrushes is made with such materials today.

Handles

Handles for toothbrushes have been fashioned from many substances, prominent among them being bone, wood, metals, rubber and celluloid and other plastics. Of these, modern plastics have emerged eminently satisfactory, combining durability, imperviousness, pleasing appearance and economy of production. Practically all toothbrushes being made currently have handle, shank and head in a single unit of cellulose or resinous plastic. Largely economic considerations have caused nitrocellulose (celluloid) to be replaced by cellulose acetate, styrene, methyl methacrylate and aceto-butyrate in the manufacture of toothbrush stocks. Handles in these substances are available in transparent, translucent, opaque, colorless and brightly colored units. They are semi-flexible, but sufficiently rigid for their purpose.

The handle should provide a comfortable grasp. It must be reasonably rigid, smoothly finished, strong and relatively straight. Handles 4 to 5 inches long, ⅜ to ½ inch wide and 3/16 inch thick have been found satisfactory. The shank should be constricted in width and alined on the same axis. To twist, curve, offset or angle the handle in respect to the brushing plane or the head tends to complicate manipulation of the brush, although gross deviations less than twenty-five degrees are probably inconsequential.

Head and Tuft Design

Toothbrushes for general use are designed arbitrarily to meet the requirements of utility, efficiency and cleanliness. A large number of patterns have been developed, many of which are without physiological basis, and others of which are limited in their application to certain teeth or tooth areas. Kauffmann[10] mentions 500 patents for toothbrushes registered in the United States in 1932. Comparatively few of these toothbrushes are manufactured at the present time.

Five designs (Fig. 2) predominate in toothbrushes available today: (1) oval or convex, (2) tufted end, (3) sloping, (4) tufted end and sloping and (5) straight trim. The last, when designed with a small narrow head, is commonly referred to as the "professional" type, and is most economical of materials and simple in construction, advantages found particularly pertinent during the period

*Since toothbrushes vary greatly in the number and the length of bristles and their arrangement, texture cannot properly be indicated by the comparative resistance of individual filaments or samples of bristling. Classification by stiffness is arbitrary. Specific standards do not exist. More than 95 per cent of toothbrushes are indicated as being "hard" or "medium."

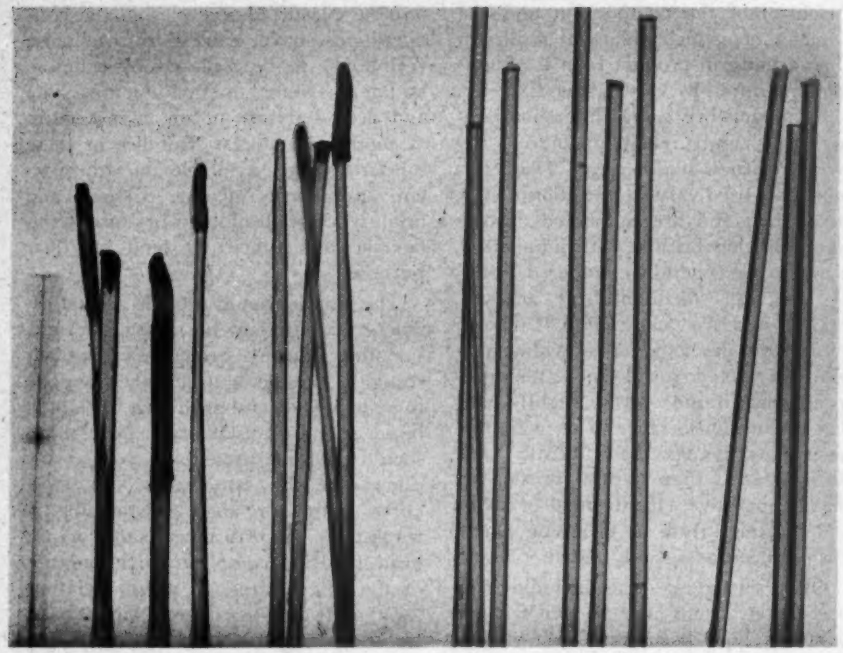

Fig. 1.—Natural and synthetic tufting materials: *A*, butt ends of 3½ inch white hog bristles. *B*, nylon filaments. Note lack of physical uniformity in *A* as compared with *B*.

of wartime material shortage. It is a pattern preferred by experts (Table 3) by reason of its close conformity to functional requirements.

The logical basis of design is the alinement of the teeth and the presence of anatomic structures restricting manipulation of the brush. Critical considerations are the mesiodistal convexity of the outer aspect of the arch, the corresponding concavity of the lingual aspect and the potential space between the ramus of the mandible and the buccal surfaces of the maxillary molar teeth.

The head, that part of the stock containing the bristles, should be limited in size to allow maximum maneuverability in all parts of the oral cavity. It should be no longer than 1⅜ inches in adult brushes or 1 inch in brushes for children, nor wider than ½ inch or 5/16 inch, respectively. Arching and excessive tapering should be avoided to permit relative uniformity in the length of the tufts and in the spacing between them.

The length of the brushing surface (length of tuft rows) should be sufficient to cover the approximate width of three adjacent teeth. A longer brushing surface is unwieldy and inefficient; a shorter one is too tedious in operation. This dimension is 1 inch to 1¼ inches in adults and ¾ inch to 1 inch in children.

The number of tuft rows is dependent on the width of the head and the diameter of the tufts. Maximum head width readily accommodates up to three rows with diameters generally employed.

Table 3.--Summary of Replies to A.D.A. Questionnaire on the Toothbrush

Items of Design	Adult's Brush				Youth's Brush				Child's Brush			
	First Preference	Number*	Second Preference	Number*	First Preference	Number*	Second Preference	Number*	First Preference	Number*	Second Preference	Number*
Head length.....	1¼ inch	34	1-3/8 inch	10	1 inch	21	1¼ inch	19	1 inch	25	3/4 inch	17
Head width.....	3/8 inch	38	1/2 inch	17	3/8 inch	37	1/4 inch	9	5/16 inch	20	3/8 inch	14
Rows.....	2	45	3	17	2	49	3	8	2	52	3	5
Row lengths.....	1 inch	49	1¼ inch	10	1 inch	30	3/4 inch	23	3/4 inch	45	1 inch	11
Tuft spacing.....	1/8 inch	30	†	--	1/8 inch	24	3/16 inch	14	1/8 inch	24	1/16 inch	16
Tufts per row.....	6	50	7	8	6	28	5	20	5	27	6	11
Trim.....	Tufts of equal length preferred for all brushes by sixty of the sixty-five replies.											
Tuft length.....	1/2 inch	35	7/16 inch	19	1/2 inch	22	7/16 inch	16	3/8 inch	30	5/16 inch	11
Stiffness.....	Hard	44	Medium	16	Medium	33	Hard	22	Medium	38	Soft	12
Over all length.....	6½ inch	37	6 inch	21	6 inch	31	6½ inch	14	5½ inch	23	5 inch	15
Handle length.....	5 inch	29	4½ inch	24	5 inch	31	4½ inch	13	4 inch	26	4½ inch	21
Handle shape.....	Straight handle in axial alinement with shank and head preferred for all brushes by more than fifty of the sixty-five replies.											

*Number of returns from total of sixty-five.

†Remainder almost equally divided among one-sixteenth, three-sixteenth and one-quarter inch.

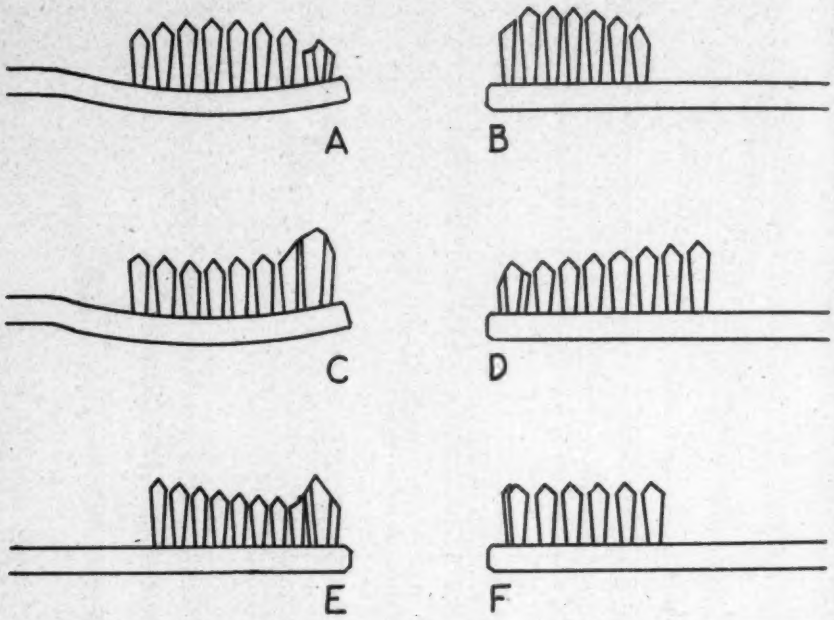

Fig. 2.—Predominant toothbrush designs: *A, B,* oval; *C,* tufted end; *D,* sloping; *E,* tufted end and sloping; *F,* straight trim.

Inter-row spacing should be sufficient to permit full use of the flexibility of the bristling, and should promote cleansing, drying and exposure to sunlight or other disinfecting agents. Unusually close spacing of tufts may hinder removal of dentifrice and debris from between the tufts.

The number of tufts per row is dependent on the length of the head and the diameter of the tufts. Maximum length of the head allows the alinement of six to eight tufts of usual diameter.

The diameter of the tufts is determined by the size of the holes drilled into the head to receive them. Usually employed diameters vary from 0.073 of an inch (No. 49 drill hole) to 0.098 of an inch (No. 40 drill hole).

The length of the tufts should be approximately equal throughout the brush. Uneven tufts transmit uneven forces to the teeth and gums, thus promoting soft tissue injury, unnecessary abrasion and inefficiency. Tufts projecting at right angles to the head and between 3/8 inch and 1/2 inch have been found useful.

The trim of the bristles, for maximum contact, should be straight. Only a linear brushing surface is adaptable to all exposed dental surfaces. Individual tufts tapered into short cones at their extremities permit easy insertion into interproximal and occlusal recesses. Trimming the lateral rows so as to produce a rounded brushing plane may eliminate undue abrasion in the hands of the untrained user.

The stiffness of the brush should conform to individual requirements. Toothbrushes should be available in every useful texture. Workmanship should be excellent and the bristles well secured.

Summary

Toothbrushes, as they are known today, probably came into being two or three hundred years ago. They developed arbitrarily into numerous patterns, many of which are extremely inefficient and even harmful as universal instruments. Recently crystallized professional opinion recognizes the advantages of compactness and simplicity of design by favoring relatively small, straight-trim brushes. Synthetic bristling filaments of nylon have largely supplanted hog bristles since 1938. They are more durable and elastic than natural bristles, but their relative merit as cleaning agents has not been determined. Celluloid for handles has been replaced by acetate, methacrylate and butyrate. It is to the credit of the War Production Board that adequate supplies of critical materials were allocated to meet military and civilian requirements for toothbrushes during the war period. Growing recognition of the importance of oral hygiene in the maintenance of general health and well being has rendered the toothbrush deserving of careful study.

ORAL SURGERY IN AMPHIBIOUS WARFARE

Rex B. Foster, D.D.S., Waterloo, Iowa*

During the various campaigns of the Central Pacific, a great number of men with jaw fractures and facial injuries were brought aboard our hospital ship by means of amphibious ducks and small boats directly from the beachheads. A small percentage were taken from transports, which had received them from the beach and administered shock treatment along with treatment of the soft tissues, no attempt being made to reduce fractures of the facial bones or jaws. The majority came to us direct, in from four to seventy-two hours after injury. These cases had received emergency treatment only in the way of pressure dressings to control hemorrhage, and morphine.

The problems faced aboard ship are vastly different from those faced in the civilian practice of oral surgery. First, the patient will have undergone a severe emotional strain. He may have been on the beach for many hours, awaiting evacuation under conditions permitting only limited emergency treatment. He may have been on reduced rations for days and enjoyed at the best only a meager supply of water. He will not only present a picture of nervous and physical exhaustion, but also one of marked dehydration from lack of liquid intake as well as from loss of blood volume. Secondly, working conditions present definite problems.

The primary mission of a hospital ship is to save lives, and this work must of necessity supersede repairs. Often, our load of casualties would come aboard in a short period of time, thus taxing the operating rooms beyond capacity. Therefore, all chest, abdominal and head injuries, because of their seriousness, take priority over jaw fractures in the operating room schedule. A dental surgeon aboard a hospital ship facing this problem must make a choice between handling his cases in a manner adaptable to the dental facilities and permitting

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The opinions or assertations contained herein are the private ones of the writer and not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large. (Art. 113 [2] U. S. Navy Regulations.)

valuable time to elapse before he can secure a place in the operating room schedule.

My experience has more than ever convinced me that time is an important factor in the successful handling of the majority of jaw fractures, and the importance of early reduction cannot be overemphasized in the case of respiratory embarrassment or the presence of potentially infected material in the throat and airways. Drainage is greatly facilitated through normal channels created by correct positioning of fragments. By conservative methods, with local anesthesia, we were able to handle all but three of the many extensive maxillofacial wounds. A hospital cart was used and, with the head of the cart toward the dental unit, suction was possible, and we had an emergency operating table.

The third problem lay in the fact that no special appliances were available for maxillary fractures or for the special needs of fixation.

Fourth, and by no means always the least problem, was the rough weather underway, with blackouts increasing the intensity of the heat and the difficult conditions existing in combat zones.

Oral surgical work aboard a hospital ship, owing to the short time allotted for treatment, constitutes merely a stepping stone in the successful treatment of maxillofacial casualties, and the goal at all times must be a service that will make a direct contribution to the end-result.

In our efforts to meet this challenge, we adopted the following procedure:

1. Early reduction.

2. Anesthesia. Conservative treatment and reduction will relieve the embarrassment to airways and improve materially the anesthetic risk. Local procaine 2 per cent is used for nerve block; 1 per cent procaine for infiltration. A general anesthetic is contraindicated, but may be required for associated wounds.

The use of procaine, aided by the temporary anesthesia created by trauma to nerve endings and nerve trunks in their canals, makes possible manipulation free from pain, which forty-eight hours later would cause great discomfort.

3. Treatment. Débridement should be conservative. All easily accessible foreign bodies and all completely detached splinters of bone should be removed. Foreign bodies buried deep or near vital tissues are left until there is less danger of hemorrhage.

Any fragment of bone having even partial soft tissue attachment is not to be removed. Radical removal of these pieces is disastrous, retarding and prolonging healing.

All irreparably loosened teeth and those involved in the line of fracture should be removed. If the tooth in the line of fracture is to be retained, a through and through prophylactic drain should be employed for a minimum of ten days, to control suppuration.

The use of arch bar splints is the method of choice. They are simple to apply. They can be easily removed for the application of a more suitable appliance later. They can be used in segments, and partial or complete immobilization can be maintained as desired.

By means of rubber bands, slow, gradually increasing tension is employed over a period of twenty-four hours. Slow reduction aids in eliminating pain and is less traumatic to surrounding tissues. It is less likely to light up infections.

Prophylactic drains were placed in all grossly comminuted areas. If pus is allowed to collect in these areas, any hope that these fragments will form a nucleus or involucrum to aid healing is vain.

Soft tissues are not sutured until splints have been applied or reduction is partially underway. Replacing the soft tissues tends to further displace jaw fragments and, once swelling takes place, access to the oral cavity is limited. It is

difficult to apply splints or Ivy loops without displacing the sutured tissues.

In a few cases, approximation of the tissues was indicated, and was successful. The majority required a conservative hands-off policy. Subdermal suturing was used to cover exposed bony tissues, to control hemorrhage and to tack flaps in place. Tincture of benzoin was applied above and below the gross laceration and a butterfly stitch placed for added support.

The use of saline packs usually proved very beneficial during the time aboard. Rough, ragged edges of seemingly hopeless tissues improved immeasurably, justifying conservative débridement. Cases received within ten hours warranted an attempt at complete débridement and approximation, and after that any attempt at radical débridement resulted in extensive sloughing and irreparable loss of tissue.

Postoperative treatment consisted in:

(a) Administration of 1 gm. of sulfathiazole at once and 1 gm. every four hours until a satisfactory blood level had been reached (in case of a bacteremia, a higher level than normal).

(b) Application of an ice bag or a moist saline pack as indicated.

(c) Forcing of fluids (a minimum of 3,000 to 3,500 cc. intake).

(d) Hot saline irrigations every four hours. A Murphy drip suspended from the ceiling gave excellent irrigation, and a pint to a quart of normal saline solution to which had been added a tablespoon of soda was used.

(e) A high caloric liquid diet.

(f) Bed rest for forty-eight hours.

(g) Administration of morphine sulfate one-eighth grain when necessary.

(h) Return of patients by stretcher to the ward. (If patients were allowed to walk, they were always accompanied by a hospital corpsman.)

(i) Maintenance of all drains and dressings undisturbed for forty-eight hours to lessen the danger of hemorrhage. The outside can be changed, if necessary, for better appearance.

(j) Use of intravenous fluids as advised by the ward medical officer.

After seventy-two hours, secondary wires were applied for complete immobilization. This procedure eliminates pain, stopping the grating and sliding of fragments against one another. Patients are definitely more comfortable, the mouth hygiene is improved immeasurably and the brightness and improved morale of the patient are beyond question.

A pair of scissors is attached to the patient by a ribbon bandage around his neck. His hospital corpsman is notified and instructed. The surgeon in charge of the ward is in turn notified. The patient is attended at all times. This is important and, to facilitate this and irrigation, the senior medical officer established a separate oral surgery ward, where the majority of the maxillofacial injuries were placed. This ward was directly forward from the dental surgery on the same deck. The dental corpsmen were on twenty-four hour watch and in complete charge of ward duties.

The wires were not placed until the patient had passed the critical stage, and not until digestive stability had been definitely established.

The following cases illustrate the types received aboard the hospital ship, and the treatment that was possible in the short period of evacuation.

Report of Cases

CASE 1.—*History.*—A private first class, U. S. Army, on August 3, 1944, received a shell fragment wound in the infra-orbital region, left side.

Examination.—There was gross destruction of the soft tissues and left half of the maxillae. All teeth from the left central incisor to the second molar were missing. There was gross displacement of the left half of the maxillae downward and lingually. The roof

Fig. 1 (Case 1).—Comminuted maxilla.

of the mouth was badly lacerated and there was a large opening into the antrum and floor of the nose. The soft tissues of the face and palate had been sutured. There was crepitus in the lower right molar area. The lower first molar was broken at the gum line. There was marked malocclusion. The upper left central incisor was attached to the soft tissue and buccal plate only. The entire maxilla was loose.

X-Ray Examination.—Fracture of the mid-portion of the right side of the mandible was revealed, with fragments in fair position. There was a fracture of the left side of the maxillae with marked lateral displacement of the alveolar ridge. The floor of the left antrum and its lateral walls were also involved.

Diagnosis.—Gun-shot wound of the face, with fracture of the mandible and maxilla, was diagnosed.

Treatment.—Arch bars, upper and lower, were placed under local anesthesia. Metal blocks, constructed from coat hanger wire, were drilled for the wire and a screw set and a metal hook soldered on for the attachment of the wires through the cheek. When the wires were passive and properly positioned, soft solder was melted to the wire, screw and block to make the position positive. A substitute for a turn buckle was fashioned (by Chief Pharmacist's Mate A. J. Chirriello, dental corpsman) by soldering an eyelet to a screw, using two nuts on the top for a positive lock. Though simple in design, this device was a great aid.

Sulfathiazole, 2 gm., was given immediately and 2 gm. in four hours, then 1 gm. with an equal amount of sodium bicarbonate every four hours. Fluids were forced and a liquid diet was prescribed and an ice bag applied immediately. One-eighth grain of morphine was given as needed. An injection of 2,000 cc. of 5 per cent glucose in a physiologic solution of sodium chloride was given immediately and hot irrigations were prescribed, to be given three times daily.

August 4, a plaster headcap and traction

Fig. 2.—Left: Comminuted maxilla; wires attached to lower arch bar. Right (Case 2): Complete disarticulation of maxilla; wires attached to upper arch bar.

appliance were employed, with wires through the cheek to the lower Winter splint. Rubber band traction was applied with through-and-through drainage at the angle, right side.

August 7, since the reduction of the maxilla was satisfactory, traction was discontinued and secondary wiring was fixed. All sutures were removed from the face to reduce scarring, butterfly stitches being used in replacement. Suturing was unsuccessful.

August 20, the prophylactic drain was removed. Progress was satisfactory. (Fig. 1 and Fig. 2, left.)

CASE 2.—*History*—A pharmacist's mate third class, U. S. Naval Reserves, presented complete disarticulation of the maxilla. (Fig. 2, right.)

Treatment.—Wires were attached to an upper arch bar, through the cheek. Soft tissue suturing was only partially successful. Articulator parts used as hooks were soldered to the head appliance when the wires were correctly positioned. An arch bar was attached to the lower bar for correction of the occlusion by rubber band traction.

CASE 3.—*History.*—A pharmacist's mate third class, U. S. Naval Reserves, was admitted to the surgery, May 7, 1944, for an injury incurred March 27, 1944, a shell fragment wound through the symphysis.

Examination.—The entire segment of the mandible, from cuspid to cuspid, was missing. The arch had collapsed and malocclusion was extreme. There was a through-and-through hole the size of a half dollar in the anterior part of the mouth. The lip was badly swollen.

X-Ray Examination.—A badly comminuted fracture of the entire anterior portion of the mandible, with considerable downward displacement of many small fragments, was revealed.

Diagnosis.—Gun-shot wound of the face, with fracture of the mandible and symphysis comminuted and missing, was diagnosed.

Treatment.—On examination, the apparently comminuted bone had been removed and a tight through-and-through pack of vaseline gauze placed well into the floor of the mouth. The right and left first bicuspids were wired into contact.

Arch bars were applied to maintain normal space between bicuspids and secondary wires applied for complete immobilization. Butterfly stitches were taken to support the soft tissues. An ice bag was applied immediately. Sulfathiazole, 2 gm., was given immediately, and 1 gm. with an equal amount of sodium bicarbonate every four hours thereafter. Fluids were forced and liquid food given every two hours.

Fig. 3 (Case 3).—Left: Radical removal of comminuted bone (contraindicated). Right: Reduction completed. There was no bone from first bicuspid to first bicuspid.

Course.—July 8, progress was slow and there was considerable pain.

August 10, through-and-through drainage was established. Progress was satisfactory. (Fig. 3.)

CASE 4.—*History.*—A private first class, U. S. Marine Corps Reserves, was admitted to the surgery July 5, 1944, because of a shell fragment wound received July 2.

Examination.—The point of entrance of the fragment was the symphysis. The soft tissue and the mandible from cuspid to cuspid had been destroyed. There was gross laceration and gross edema. Malocclusion was marked.

X-Ray Examination.—A badly comminuted fracture of the entire anterior portion of the mandible was revealed. The right side was displaced downward.

Diagnosis.—Gun-shot wound of the face, with gross destruction of the mandible, was diagnosed.

Treatment.—At the time of examination, the arch had been collapsed and the lower bicuspids were wired into contact. The bone was denuded and exposed to the lower border of the mandible. All buccal tissue had been stripped away. It was impossible to examine the floor of the mouth owing to wiring in the collapsed position.

Under local anesthesia, the segments were released by removal of the wires. A large fragment with four anterior teeth present was attached to lingual soft tissue lying in the floor of the mouth and hidden under the tongue. Jelenko splints were attached to the upper and lower jaws and the fracture was reduced and anterior fragment restored, and the secondary wires were placed. The buccal mucosa was sutured in place.

It was believed doubtful whether the anterior fragment would live owing to the time lost between injury and fixation.

An ice bag was applied immediately, and 2 gm. of sulfathiazole was given, the therapy continuing with 1 gm. every four hours with an equal amount of sodium bicarbonate. Fluids were forced and liquid food was given every two hours.

Course.—July 8, progress was considered satisfactory. (Fig. 4.)

CASE 5.—*History.*—A private first class, U. S. Army, received a small caliber bullet wound, with the point of entrance on the right side just below the angle of the jaw, the bullet exploding through the left side of the mandible in the molar region.

Examination.—There was gross displacement with crepitus. The position of the mandible made breathing and swallowing difficult.

Diagnosis.—Gun-shot wound of the face, with fracture of the mandible, was diagnosed.

Fig. 4 (Case 4).—Left: Condition before reduction; bicuspids contacting and wired in contact. Right: Reduction complete; time element against a favorable prognosis.

Treatment.—On examination, an emergency headband and tongue blades had been employed for forward positioning of the mandible to place, to relieve breathing.

Under local anesthesia, Winter splints and a compound block were used to control the posterior edentulous fragment, with rubber band traction. An ice bag was applied immediately. Sulfathiazole, 2 gm., was given immediately, and repeated in four hours. Thereafter, 1 gm. with an equal amount of sodium bicarbonate was given every four hours. Fluids were forced and a liquid diet was prescribed. Hot irrigations were employed twice a day. One-eighth grain of morphine sulfate was given as needed.

August 10, the swelling in the floor of the mouth was increasing.

August 12, through-and-through drainage was established on the left side, with secondary wiring.

August 14, the swelling was decreasing. The temperature rose to 105 and the case was referred to the medical department.

August 16, there was dizziness, with ataxia. Physical examination was negative. Spinal puncture yielded a clear fluid, with pressure normal.

August 19, there was a secondary hemorrhage. The compound block was removed to facilitate packing to check hemorrhage

Fig. 5 (Case 5).—Emergency tongue-blade treatment for forward positioning of mandible. Respiratory embarrassment was relieved.

Fig. 6 (Case 5).—Left: Marked displacement of mandible, resulting in respiratory embarrassment. Right: Marked edema, which was always present with mandible in position shown, with mouth open. A tracheotomy tube was used to relieve respiratory embarrassment.

and to prevent the accumulation of blood. It was impossible to stabilize the posterior fragments because of restlessness of the patient.

August 21, the pack was removed. There was no drainage and the prophylactic drain was removed.

The fever and ataxia present from August 13 to 18 could not be explained. As the fever subsided, the symptoms disappeared. The patient felt well, but extremely weak. There was slight drainage through the left side. In spite of the fact that the high temperature and swelling made satisfactory treatment of the fracture impractical, no respiratory embarrassment was experienced. (Figs. 5-6.)

CASE 6.—*History.*—A private first class, on June 22, 1944, was hit by a shell fragment, with the point of entrance over the left second molar and exit through the mandible at the symphysis, carrying away all the teeth and causing gross laceration of the soft tissues.

Examination.—The arch form was destroyed and chin depressed. The ridge was destroyed from the left second molar to the retromolar triangle on the right side. There was extensive edema. The lower lip was lacerated and the soft tissue destroyed. A tracheotomy tube had been inserted.

X-Ray Examination.—There was a severe comminution of the entire portion on both sides with total destruction of the normal structure.

Diagnosis.—Gun-shot wound of the face, with gross destruction, and fracture of the mandible, was diagnosed.

Treatment.—June 23, a compound and a Jelenko splint were placed to control the arch form with circumferential wiring to the compound saddle over the Jelenko splint. Rubber band traction was applied, with a pressure bandage to control the anterior fragments.

June 24, there was extensive edema, extending to the upper lip and the tongue. The posterior one-half of the arch was in good position bilaterally.

June 25, an acrylic splint was applied to the lower jaw, with a headcap for traction. The patient was improving and was comfortable. The arch form was established and the sagging anterior area was in fair position, being controlled by the acrylic splint to the headcap. (Figs. 7-9.)

Fig. 7 (Case 6).—Left: Acrylic chin cup used in lieu of circumferential wiring, which was not possible at this time. Right: Open mouth gross edema of soft tissues and tongue.

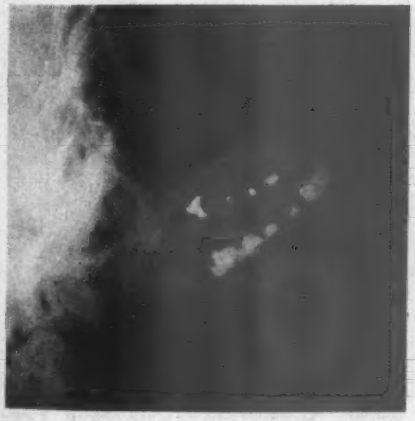

Fig. 8 (Case 6).—Condition before reduction.

Fig. 9 (Case 6).—Reduction as nearly complete as time would permit.

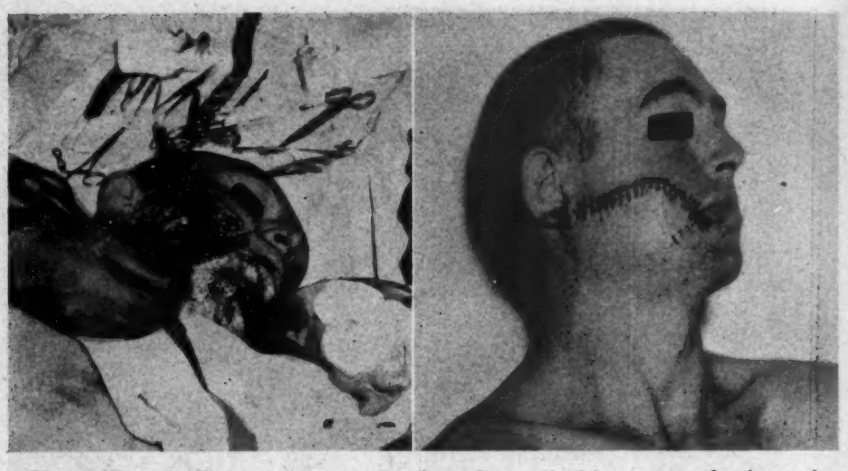

Fig. 10 (Case 7).—Left: Appearance of patient when received in surgery, a few hours after injury. Right: Suturing completed before reduction of fractures. Splints were applied the following day.

Soft Tissue Wounds

Most of the early suturing of soft tissues in face wounds was done by the medical officers, on their respective wards, and by the operating room teams by whom the patients were first seen. Occasionally, a case promising sensational results was received, but most of the cases presented difficult soft tissue problems because of swelling, suppuration and the long time elapsing between injury and treatment. The care of these cases was our responsibility.

CASE 7.—*History.*—A corporal in the U. S. Marine Corps received a bullet wound of the face, June 9, 1944. The weapon was of 32 caliber and had been fired at close range.

Examination.—The soft tissues were torn loose from the lobe of the ear diagonally to the corner of the mouth, extending downward in a three-cornered tear. The mandible was exposed, being stripped of all periosteum from cuspid to second molar. The first molar and the second bicuspid were broken at the gum line. There was free bleeding. The lobe of the ear had been split. There was marked malocclusion. The muscles were badly lacerated.

X-Ray Examination.—There was a linear fracture of the mandible through the ramus on the right just back of the third molar. The first molar and bicuspid on this side were shattered. The fragments of the fractured bone were in good position.

Diagnosis.—Bullet wound of the face, with fracture of the mandible and of the right maxilla, was diagnosed.

Treatment.—Under local anesthesia, the tissues were sutured and a pressure bandage was applied, at the time of examination. The tissues were badly swollen. Jelenko splints were applied and rubber band traction was started. Pressure dressings were reapplied. An ice bag was kept on the face. Fluids were forced and the diet was liquid. Sulfathiazole was given, 15 grains every four hours. Morphine sulfate one-eighth grain was given as needed. Hot saline irrigations were given three times a day. Owing to the swelling of the soft tissues and the danger of tearing out the plastic sutures, extraction of roots was delayed.

June 22, one-half of the sutures were removed, being replaced by butterfly stitches. Progress was satisfactory.

June 23, all of the sutures were removed, being replaced by several small butterfly stitches. Secondary wires were placed. Progress was satisfactory. (Fig. 10.)

CASE 8.—*History.*—A pharmacist second

Fig. 11.—Left: Extensive soft tissue damage, marked edema and suppuration. Supportive treatment only was indicated. Right: Appearance of patient. Supportive treatment was given in an effort to save as much soft tissue as possible, with a view to plastic surgery at a later date.

class (V-2), U. S. Naval Reserves, was struck by a mortar fragment, July 21, 1944, with point of entrance below the orbit over the bicuspid area on the right side, and exit through the mouth.

Examination.—There was gross destruction of the soft tissues, with marked malocclusion and crepitus in the angle on the right side. The upper right molars had been driven lingually and were displaced down-

Fig. 12.—Left: Case in which moist packs were used to reduce swelling and save maximum amount of tissue. Right: Principle of butterfly stitch.

ward. There was a vaseline pack tightly in place.

X-Ray Examination.—There was a badly comminuted fracture of the angle on the right side involving the lower portion of the ramus. The floor of the right antrum was also fractured.

Diagnosis.—Gun-shot wound of the face, with fracture of the mandible and fracture of the right maxilla, was diagnosed.

Treatment.—Under local anesthesia, Winter splints were applied. The maxillary fracture was reduced and rubber band traction was applied. Fluids were forced and a liquid diet was prescribed. Hot irrigations were given three times a day.

July 29, the tissues of the face were tacked lightly in place by subdermal sutures, butterfly stitches and secondary wiring. The butterfly stitch was employed to support the soft tissues in an attempt to save all tissue possible to aid in the final repair by plastic surgery. (Figs. 11-12.)

My observations of the maxillofacial injury cases received on shipboard have served to strengthen my belief that a conservative policy should be followed in the handling of fractures of the face and jaws and that the importance of early reduction cannot be overemphasized.

Local anesthesia is to be preferred. Appliances should be of such construction as to permit simplicity in adjustment and ease of removal in case of a change in treatment.

Radical procedures are to be strictly avoided.

714 James Black Building.

"LINERS" FOR DENTURES

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Introduction

Among the newer materials offered to the dental profession, the resin liners for dentures have created an unusual interest. The resurfacing of a denture with a plastic material that will flow to position and subsequently harden in the mouth would undoubtedly be an attractive, time-saving and practical procedure. That such a material would receive immediate attention from the dental profession is evidenced by the number of requests for information received by the Research Commission of the American Dental Association and the American Dental Association Research Fellowship at the National Bureau of Standards.

The present investigation was undertaken to determine the properties of these materials and their effects on the properties of methyl methacrylate denture base resin.

Materials Investigated

The following materials have been used in this study:

Dr. A. P. Craig's Permanent Liner, Craig Dental Products, Inc.

Fink Permanent Liner, Plastodent, Inc.

Getz—400 Permanent Liner, The William Getz Co.

Permadent Reliner, Dental Research Laboratories.

Stardent Permanent Rebaser, Star Dental Manufacturing Co., Inc.

Tri-Tex, Bell Dental Products Co., Inc.

All samples of these materials were purchased through regular dental trade channels and were selected as representative of the more widely advertised products. With the exception of Permadent and Tri-Tex, all samples were viscous liquids and were supplied in

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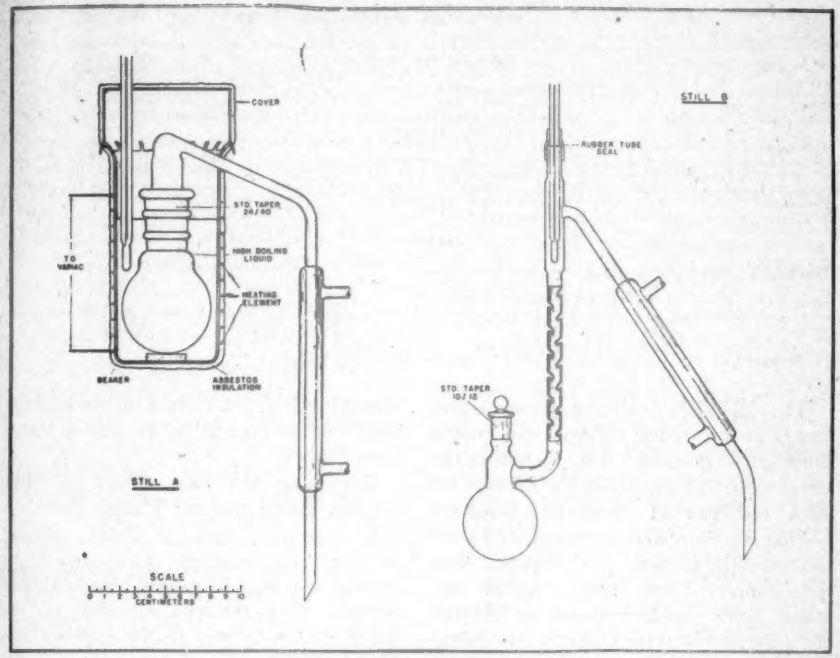

Fig. 1.—Stills for determining composition.

collapsible metal tubes. Permadent had a plastic consistency and was furnished in glass jars. Tri-Tex was sold as a powder and a liquid to be mixed by the dentist.

Analysis and Composition

In order to acquaint the dental profession with the nature of the materials being introduced into patients' mouths, chemical analyses of these materials were undertaken. As the nature of the materials indicated the presence of volatile solvents, the first step was to separate the solvents by distillation. Two small stills were constructed for this purpose. The first (Still A in Fig. 1), having a capacity of 100 ml., was used for separating solvent, resin and plasticizer, and for depolymerizing the resin in order to identify the monomer. The heating jacket was constructed so that the still was completely enclosed to the inlet of the condenser. With this arrangement of the jacket, there was no reflux return or local heating. The heating element was wound around the jacket, which was insulated with asbestos. The jacket was filled to the level of the top of the still pot with a liquid (Dow Plasticizer No. 5) that could be heated to 250°C.

The second still (Still B, Fig. 1), having a 50 ml. still pot and a six-inch reflux column containing a thermometer, was used for determining boiling point curves and for separating liquids whose boiling points were relatively far apart.

A 15 to 25 gm. sample of liner was placed in the first still and the bath heated to temperatures between 200°C. and 210°C. The temperature was maintained for an hour or two or until the rate of distillation decreased to less than one drop per minute.

Table 1.--Analyses of Liners

Liner	Solvent (Per Cent)	Resin (Per Cent)
Dr. Craig's	65 ethyl acetate	35 methyl methacrylate
Fink	55 amyl acetate	45 methyl methacrylate
Getz--400	45 mixture containing about 50% diethyl carbonate	55 methyl methacrylate
Stardent	40 diethyl carbonate	60 methyl methacrylate
Liner	**Plasticizer (Per Cent)**	**Resin (Per Cent)**
Permadent	60 triacetin (glyceryl triacetate)	40 methyl methacrylate
Liner	**Liquid**	**Powder**
Tri-Tex	70% diethyl carbonate 30% "low boiler" (B.P. 57-59° C.)*	methyl methacrylate

*Mixture of low boiling point solvents; not identified.

The distillate (solvent) was transferred to the second still and the boiling point curve determined by recording the temperature at the top of the column for each milliliter of distillate. Constant boiling fractions were removed, and their indices of refraction* and densities were determined. These three physical constants were usually enough to identify the solvent. In some cases, it was necessary to use the methods of organic analysis to identify the solvent completely.

After completion of the distillation in the first still, there was a residue in the still pot consisting of resin and, in one case, of resin and plasticizer. The still was then removed from the jacket, and direct heat was applied to the still pot in order to depolymerize the resin and to distil the monomer and plasticizer. Plasticizer and monomer were readily separated in the second still.

The compositions of the liners as determined in this investigation are given in Table 1.

Toxicity and Irritation

Reference to books on the toxicity of industrial solvents reveals that irritation of the mucous membranes may be expected and that toxic effects are possible through the use of certain of the solvents identified as present in the lining materials studied.

Regarding the local effect of ethyl acetate, Lehmann and Flury[1] state:

> Irritates the membranes of the eyes and the respiratory passages. Temporary slight corneal cloudings have been observed. Skin diseases after repeated cleaning of the hands with a mixture of spirits and acetic ether. Inflammation of the gums after inhalation of the vapors.

Under the heading "Industrial Poisonings," Lehmann and Flury comment as follows:

> According to Oettel, ethyl acetate causes no acute or delayed skin symptoms on human skin after a single action lasting for five hours. However, it has an irritating effect on the mucous membranes. According to Englehardt workmen easily acquire eczema from it.
>
> Hence ethyl acetate is not at all as harmless as many people have assumed.

Browning[2] states that the local irritative effect of ethyl acetate is about the same as that of methyl acetate and con-

*The indices of refraction were determined by Dr. Charles P. Saylor, of the staff of the National Bureau of Standards.

1. Lehmann, K. B., and Flury, Ferdinand: Toxicology and Hygiene of Industrial Solvents. Baltimore: Williams & Wilkins Co., 1943.

2. Browning, E. (compiler): Toxicity of Industrial Organic Solvents. Medical Research Council, Industrial Health Research Board, Report No. 80. London: His Majesty's Stationery Office, 1937.

siderably less than that of amyl acetate. She continues:

> There is little evidence that much danger is to be apprehended from the chronic effects of ethyl acetate especially as a metabolic poison. Zangger places it with butyl acetate in the group of substances which he regards as the least toxic of the organic solvents; he considers it essentially less toxic than acetone, amyl acetate, and methyl acetate. In general ethyl acetate appears to be regarded as a less toxic substance than methyl acetate for industrial use, in spite of its greater acute narcotic effect.

Browning makes the following statement regarding amyl acetate:

> The chief symptoms observed in workers exposed over long periods to atmospheres containing amyl acetate are those of irritation of mucous membranes, but slight disturbances of general health have also been reported.

Under "Local Effect" of amyl acetate, Lehmann and Flury[1] list irritation of the mucous membranes of the eyes, nose and mouth, conjunctivitis and irritation and catarrhs of the upper and lower respiratory passages. They report further that Oettel, in investigations of the effect of chemical substances on the human skin, found that amyl acetate had no effect on the skin after a single application lasting five hours. They conclude with the statement: "Amyl acetate cannot be called a harmless solvent by any means."

Browning[2] reports that no toxic effects from industrial use of diethyl carbonate have been recorded, nor have animal experiments been carried out. She refers to Durrans, who states that diethyl carbonate has a faintly lacrimatory aftereffect, similar to that of ethyl chloroacetate.

Triacetin (glyceryl triacetate) is listed in the U. S. Pharmacopeia as an ingredient of cosmetics. It is employed in salves and creams.

Irritation of the mouth tissues would be expected from local application of all of these solvents, with the possible exception of triacetin. The effect of a pellet of each of the lining materials placed on the tongue corroborated this expectation. Those materials containing ethyl acetate, amyl acetate or diethyl carbonate gave immediate rise to a strong burning sensation; with the material containing triacetin, the burning sensation was much less. Certainly the patient should be kept under observation from the initial application of one of these liners until the greater part of the solvent has left the surface of the lining. This may require several weeks.

Physical Properties of Liners and Their Effect on Base Resin

Setting.—The chemical analyses show that these liners are solutions of resin or highly plasticized resin, and, therefore, the setting action must consist of evaporation, leaching or diffusion of the solvent or plasticizer. When the liner material of the solvent resin type is exposed, a very thin solid film is formed which offers little resistance to evaporation of solvent; consequently, the rate of loss of solvent is extremely large. With the continuation of evaporation, the thin solid film grows in thickness. As the evaporation or loss of solvent occurs by diffusion through the solid film, the rate of loss is dependent upon the thickness of the film, which is increasing continuously, and the concentration of solvent in the mass. When the thickness of the film has reached the point at which the increase for a given period is a very small increment of the total thickness, the concentration begins to dominate the rate of loss of solvent from the material. The concentration, that is, the amount of solvent remaining in the specimen, is lowered continuously through evaporation of solvent from the surface. A diminishing rate of loss therefore results from this factor also, so that the resulting form of the curve (see Fig. 2 or Fig. 3) may be attributed to both factors concurrently.

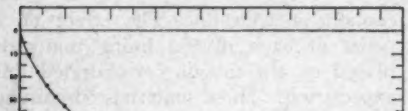

Fig. 2.—Loss of solvent during the first seventy minutes (solvent-resin type).

A simple demonstration of the rapid formation of a retarding layer and the resultant slow loss of solvent may be made by forming a pellet of liner (about 0.25 of an inch in diameter) with the fingers wet. In a few minutes, the pellet may be handled with dry hands without sticking. Furthermore, the pellet can be readily deformed, showing that the inner material is still soft. The pellet will remain in this condition for several hours.

Further evidence is the fact that a film of liner alone took several times as long to harden as did a film of liner placed on methyl methacrylate resin. The type of failure (extreme bending rather than breaking) encountered with many of the week-old and month-old transverse test specimens reported later lends support to the theory that a portion of the solvent has penetrated and softened the base resin.

For material such as Permadent, containing a nonvolatile plasticizer, the setting action appears to take place by a leaching of the plasticizer (triacetin is soluble to the extent of 7 gm. per 100 ml. of water) and by penetration of the plasticizer into the base resin. Permadent exposed to air in the laboratory did not set in two months. Permadent applied to a cake of resin (approximately 5 mm. thick) and stored in air at 37°C. had set somewhat after about three months, but the cake of resin was softened to such an extent that the point of a knife could be pushed through the liner and nearly three-quarters of the way through the cake of resin.

Two experiments were performed to determine the rate of loss of solvent from the solvent-resin type of liner. The first experiment attempted to evaluate the loss during the first hour after application, to be comparable to the period before delivery to the patient. The second experiment demonstrated the presence of solvent in the liner for the first five or six weeks.

In the first experiment, a sample of liner was squeezed from the tube onto a weighing pan, and the slumped mass was weighed immediately. Weighings were then made at predetermined intervals for the next seventy minutes, and a final weighing was made the following day.

The second experiment consisted of the determination of the loss in weight of specimens 60 mm. in diameter and approximately 1 mm. thick in air at room temperature. The disk specimens were prepared in a brass ring (60 mm. inside diameter and 8 mm. deep). The brass ring was placed on a sheet of wet cellophane on a glass plate, and the liner was squeezed from the tube onto the cellophane inside the ring. Over this was then placed another sheet of wet cello-

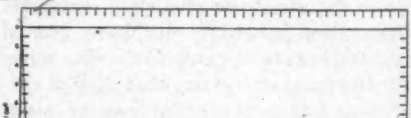

Fig. 3.—Loss of solvent for a period of thirty-eight days (solvent-resin type).

phane, a plug fitting loosely into the ring and a weight. The plug was made with a shoulder stop so that the specimen of the liner was pressed to approximately 1 mm. thickness. At the end of about one-half hour, the partially hardened film would still flow but could be handled carefully in the ring. The glass plate, plug and cellophane sheets were removed, and the specimen and ring were submerged immediately in water in a shallow dish. The trapped air bubbles under the film had to be removed in order to prevent distortion of the film. The film, having a specific gravity of approximately 1, was kept from sagging by the water. Approximately three hours later, the specimen, still in the ring, was removed from the water. At this point, the film was nearly solid throughout but was still readily deformed by its own weight. The specimen was therefore allowed to air dry for about three more hours. The specimen and ring were wiped dry and weighed. Periodic weighings were continued for more than five weeks. The specimens were kept in air at room temperature between weighings.

From these data, curves were drawn (Figs. 2 and 3) and values of rate of loss of solvent per day were calculated for the first two, ten, thirty and sixty minutes and twenty-four hours, respectively, from the first experiment, and for the seventh day and thirtieth day from the second experiment. These results are presented in Table 2. The rate of loss for the first two minutes is enormous, nearly twenty times the rate for the first day. Also the rate for the first day is about two hundred times the rate for the thirtieth day. As the curves in Figures 2 and 3 are smooth, the diminishing rate of loss of solvent must be related to physical changes in the specimens that are occurring continuously.

The curves (Figs. 2 and 3) for loss of weight with time are typical of those materials with volatile solvents and are

Table 2.--Rate of Loss of Solvent (Calculated from Losses of Solvent for Periods Shown)

Period	Rate of Loss Mg./Day
First two minutes	7,600
First ten minutes	4,700
First thirty minutes	2,900
First sixty minutes	2,100
First day	400
Seventh day	17*
Thirtieth day	2*

*Calculated from values for disk specimens. All others calculated from values for slumped mass on weighing pan.

in general agreement with results reported by others.[3] The rate of loss for any material should be directly related to the solvent used, the physical dimensions (surface area, thickness and volume) of the specimen and the test conditions. However, the curves (Figs. 2 and 3) and Table 2 show qualitatively that solvent is still being released rapidly when the lined denture is delivered to the patient (fifteen minutes to one hour, according to directions), and this release of solvent may continue for more than one month.

Shrinkage and Distortion.—The disk specimens from the experiment above exhibited shrinkage accompanying the loss of solvent. At the end of forty days, the disks, which originally were attached to the brass rings around the entire periphery, had pulled away from one side (for approximately one-half the circumference) by as much as three-quarters of a millimeter. This represents a linear shrinkage of 1¼ per cent, with no allowance for possible stretching of the disk prior to its loosening from the ring.

A shrinkage of this amount in a film of liner on one surface of a resin plate would introduce a force tending to distort the plate. Distortion was observed in the specimens used in the transverse test, the specimens becoming bowed with the lined side concave.

3. Skinner, E. W., and Pomés, C. E.: Self-Hardening Lining Materials. J.A.D.A. 32: 419, April 1945.

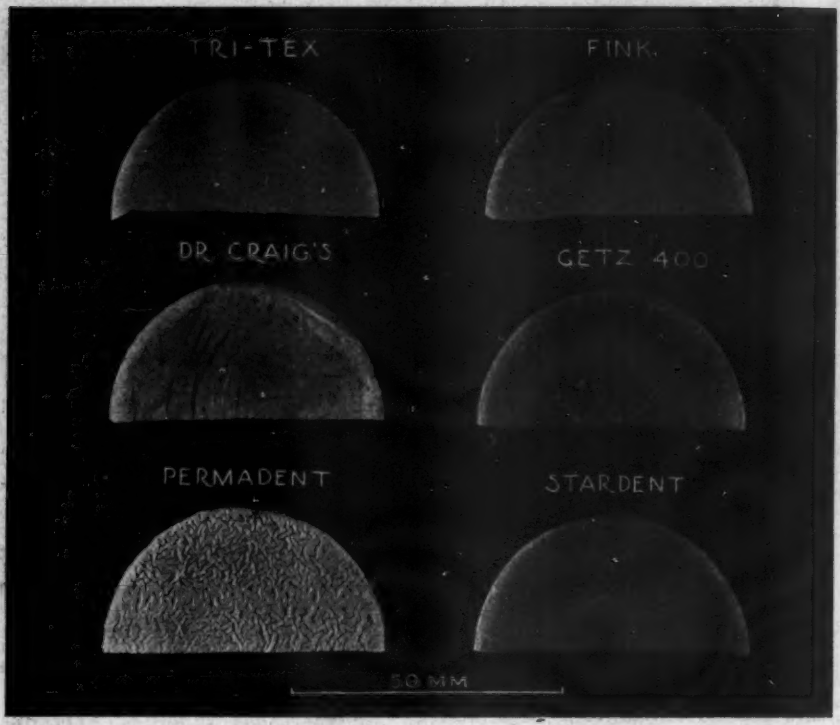

Fig. 4.—Surfaces of lined disks of denture base resin after storage for one month in water at 37°C.

A number of disks (50 mm. in diameter and 1 mm. thick) of certified denture base resins were coated on one side with the various liners and placed in distilled water at 37°C. (98.6°F.) for storage. After one month, the disks were cut in half and photographed (Figs. 4 and 5). These disks, approximately the thickness of the palatal area of a denture, illustrate the possibility of distortion resulting from application of the liners to thin sections of methyl methacrylate resin.

Effect on Strength and Stiffness of Base Resin.—Since a denture in service is a structure working under variable conditions of loading, it is apparent that the effect of a liner on the strength and the stiffness of the base resin should also be an important factor in deciding the suitability of that liner.

It was decided to use a modification of the transverse bend test as described in A.D.A. Specification No. 12[4] as a means of evaluating the effects of the liners on the strength and the stiffness of the base resin.

Test bars 10.0 mm. wide and 65 mm.

4. Revised American Dental Association Specification No. 12 for Denture Base Material, Acrylic Resin or Mixtures of Acrylic and Other Resins. J.A.D.A. 29:127, January 1942.

Also: Sweeney, W. T., and Paffenbarger, G. C.: Tentative American Dental Association Specification No. 12 for Dental Base Material, Acrylic Resin or Mixtures of Acrylic and Other Resins. J.A.D.A. 28:325, February 1941.

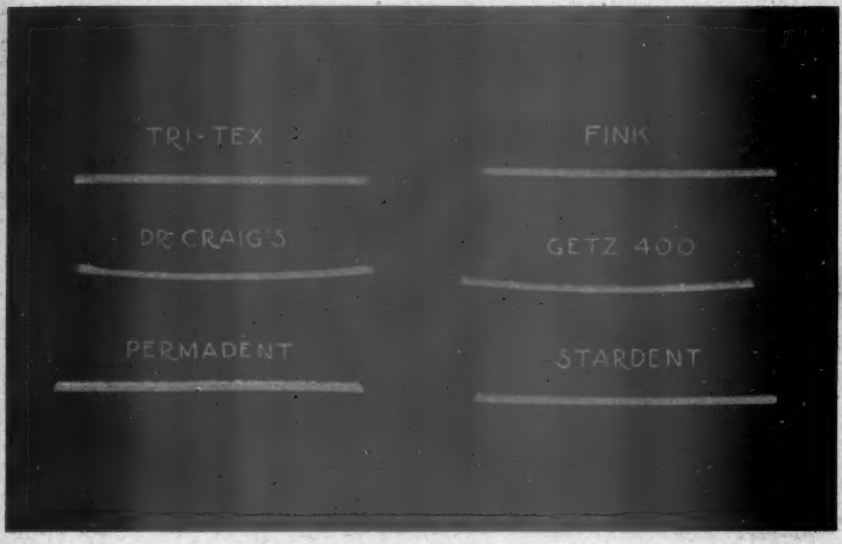

Fig. 5.—Edge view of disks in Figure 4, showing warpage.

long were cut from a sheet of Plexiglas (commercially cured and finished methyl methacrylate). These specimens were thicker by about 10 per cent than the standard (2.50 ± 0.03 mm.) used in A.D.A. Specification No. 12. The use of this material allowed all specimens to be cut from a single sheet of material, thereby eliminating any variations which might have been introduced in curing a number of cakes of resin. In addition, the amount of machine-shop work required was materially reduced, as the polished faces of the Plexiglas sheet formed two of the faces of each specimen. The suitability of Plexiglas as a substitute for the base resin in the transverse test has been demonstrated in previous work in this laboratory.[5]

The variation in thickness for any series of specimens used with any one brand of denture liner was less than 1 per cent. Direct comparisons should not be made between liners (in Figs. 6 and 7 and Table 3), however, because of variations in thicknesses of specimens of different series.

The specimens, which had been conditioned by storing in distilled water for from four days to one week, were lined on one side in accordance with the manufacturers' directions for lining dentures so far as it was possible to apply these directions. The specimens, coated on one side, were placed on a sheet of plate glass, and another sheet of plate glass was pushed down on the coatings of liner by clamps. The glass plates were kept parallel by stops, thus insuring a uniform thickness of liner on each specimen in the series. This assembly was placed in distilled water at the time that the lined denture would be delivered to the patient. The glass plates were removed after approximately two hours. All specimens were then stored in distilled water at 37°C. (98.6°F.) prior to testing.

The tests were carried out in air at 37°C. with the standard transverse bend

5. Sweeney, W. T.; Paffenbarger, G. C., and Beall, J. R.: Acrylic Resins for Dentures. J.A.D.A. 29:7, January 1942.

Table 3.--Transverse Test

Deflection

Liner	Unlined		Lined for Four Hours*				Lined for One Week*				Lined for One Month*			
	Deflection 1,500 Gm. to		Deflection 1,500 Gm. to				Deflection 1,500 Gm. to				Deflection 1,500 Gm. to			
	4,000 Gm.	6,000 Gm.	4,000 Gm.	Increase†	6,000 Gm.	Increase†	4,000 Gm.	Increase†	6,000 Gm.	Increase†	4,000 Gm.	Increase†	6,000 Gm.	Increase†
	Mm.	Mm.	Mm.	Per Cent	Mm.	Per Cent	Mm.	Per Cent	Mm.	Per Cent	Mm.	Per Cent	Mm.	Per Cent
Dr. Craig's...	1.84	3.48	3.37	100	‡		3.46	110	‡		2.50	52	9.13	162
Fink.....	1.50	3.08	1.81	21	‡		1.64	9	3.52	14	1.84	23	4.12	34
Getz--400.....	1.50	3.08	1.78	19	3.55	15	2.21	47	5.93	93	1.96	31	5.28	71
Permadent.....	1.55	3.24	1.92	24	4.24	31	2.08	34	4.68	44	2.13	37	4.62	43
Stardent.....	1.64	3.48	2.49	52	‡		2.20	34	7.29	109	2.05	25	6.34	82
Tri-Tex.....	1.50	3.08	2.17	45	‡		1.54	3	3.04	-1	1.72	15	3.94	28

Failure

Liner	Unlined		Lined for Four Hours*			Lined for One Week*			Lined for One Month*		
	Load	Type	Load	Decrease**	Type	Load	Decrease**	Type	Load	Decrease**	Type
	Gm.		Gm.	Per Cent		Gm.	Per Cent		Gm.	Per Cent	
Dr. Craig's...	7,500	All B††	5,050	33	All B	5,300	29	All P††	6,165	18	1B; 2P
Fink.....	8,250	All B	5,650	31	All B	7,280	12	All B	6,865	17	All B
Getz--400.....	8,250	All B	6,750	18	All B	6,500	21	All P	6,600	20	1B; 2P
Permadent.....	7,830	All B	6,800	13	All B	6,865	12	2B; 1P	6,330	19	All B
Stardent.....	7,500	All B	4,975	34	All B	6,425	14	1B; 2P	6,830	9	All P
Tri-Tex.....	8,250	All B	5,970	28	All B	9,065	-10	2B; 1P	7,310	11	All P

*Specimens were stored in distilled water at 37° C. (98.6° F.) after lining for periods indicated prior to test. All specimens were stored in distilled water four days to one week before lining.
†Percentage of increase in deflection over unlined specimens.
‡Specimens failed under loads of less than 6,000 gm.
**Percentage of decrease of load at failure compared with unlined specimens.
††Specimens failed by breaking.
‡‡Specimens failed by extreme bending without fracture.

testing equipment, the specimens being wiped dry just before they were placed on the fixture.

The loading schedule was as follows:

1. Fiducial load (1,500 gm.) applied at 0 time.
2. First deflection reading made at 0 minutes, 30 seconds.
3. First 500 gm. load increment (lead shot) applied between 0 minutes, 30 seconds, and 1 minute, 0 seconds.
4. Second deflection reading made at 1 minute, 30 seconds.
5. Second 500 gm. load increment applied between 1 minute, 30 seconds, and 2 minutes, 0 seconds.
6. Repeat until failure.

Blanks, that is, unlined specimens, were run for each group. The first tests of lined specimens in each case were made four hours after the specimens were placed in water, corresponding to four hours after delivery to the patient, in the case of a lined denture. Succeeding tests were made at one week and one month, the specimens remaining in water at 37°C. during these periods.

The results of these tests are shown in the curves of Figures 6 and 7. Each curve represents the average of three specimens. The deflections at 4,000 gm. and 6,000 gm. loads and the loads at failure, together with the percentage changes produced by the liners, are given in Table 3.

The average values of deflection at 4,000 gm., compared with the deflection of unlined specimens, ranged from 19 to

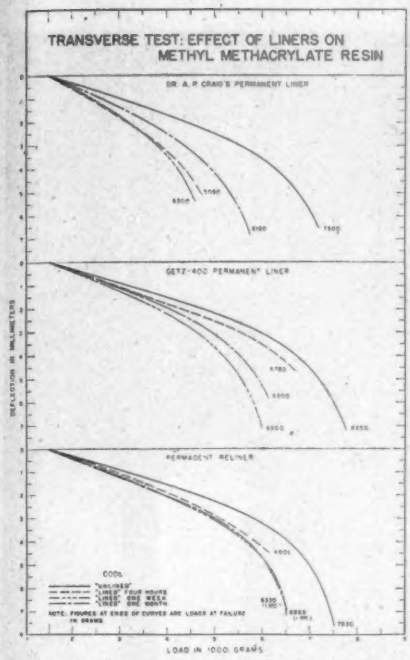
TRANSVERSE TEST: EFFECT OF LINERS ON METHYL METHACRYLATE RESIN
DR. A. P. CRAIG'S PERMANENT LINER
GETZ-400 PERMANENT LINER
PERMADENT RELINER
DEFLECTION IN MILLIMETERS
LOAD IN 1000 GRAMS
CODE
UNLINED
LINED FOUR HOURS
LINED ONE WEEK
LINED ONE MONTH
NOTE: FIGURES AT ENDS OF CURVES ARE LOADS AT FAILURE IN GRAMS

Fig. 6.—Transverse test, showing effect of liners on strength and stiffness of base resin.

100 per cent more for specimens lined four hours, from 3 to 110 per cent more for specimens lined for one week and from 15 to 52 per cent more for specimens lined for one month.

Although all of the liners do not show identical effects, the general results indicate that, four hours after the application of a liner, the strength, or load at failure, of the resin to which it is applied is reduced from 13 to 34 per cent. At the end of one week, some of the lined specimens had partially regained their strength. At one month, there was little further change.

These values become more significant when one realizes that the lined specimens are in every instance thicker than the unlined ones and should, therefore, be stronger and stiffer. In a simple beam of rectangular cross-section, the strength varies directly with the square of the thickness, while the deflection varies inversely with the cube of the thickness.

If the liners actually become part of the denture as claimed, the values for deflection for lined specimens will be identical with those for unlined specimens of the same thickness. Furthermore, the load at failure will also be identical for lined and unlined specimens of the same thickness if the lining material is actually the equivalent of an increase in thickness of the base resin. Such is not the case.

All specimens tested four hours after they were lined failed by breaking. The specimens tested after being lined for a week or a month failed, in numerous instances, by bending so much that they were pushed between the end supports without breaking. Thus, the week-old

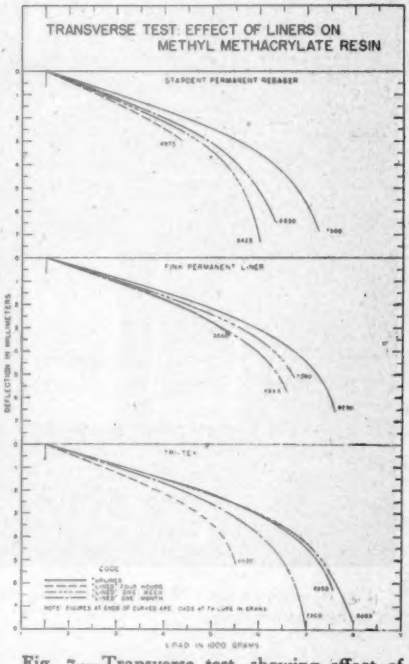

Fig. 7.—Transverse test, showing effect of liners on strength and stiffness of base resin.

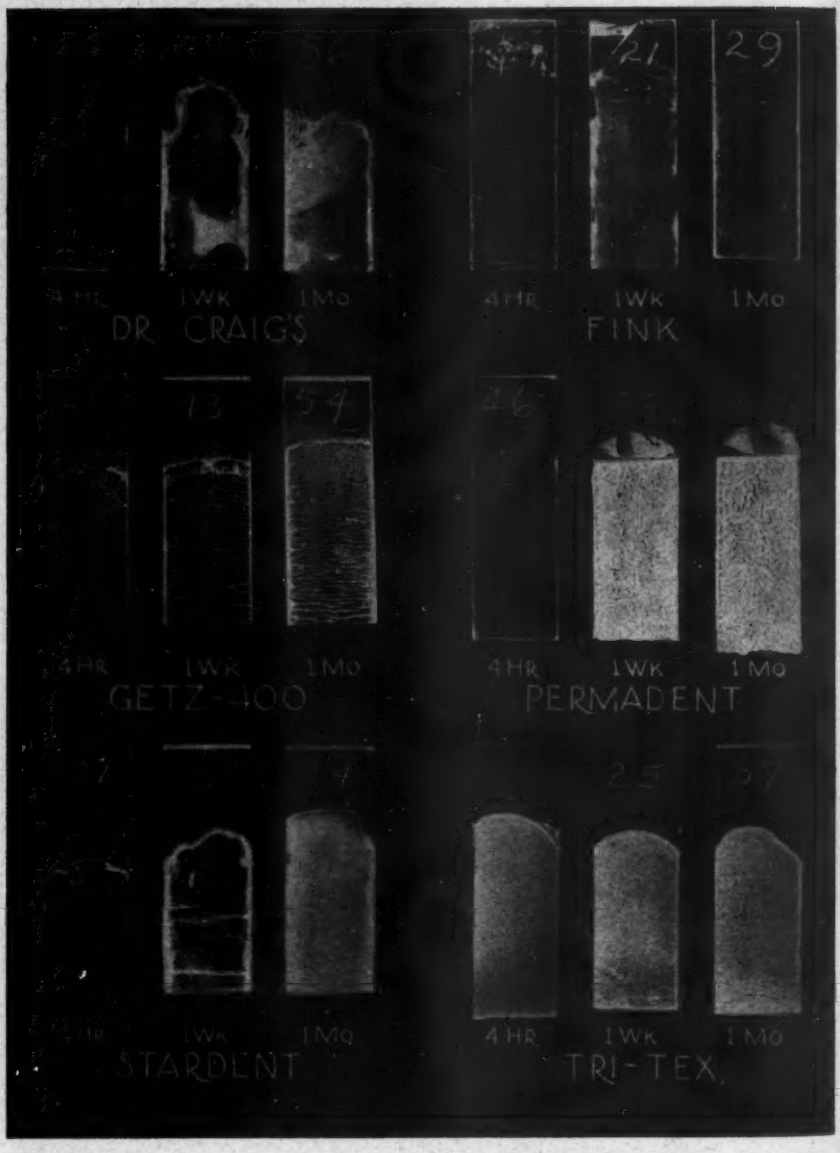

Fig. 8.—Appearance of lined specimens after storage in water for periods shown and testing in transverse bending.

and month-old specimens acted as though they were softer and more flexible than those four hours old.

Therefore, when adding material to the resin in the form of one of these liners, one is not effectively increasing the thickness of the denture with an addition of denture material, but is actually injuring the denture by decreasing the strength and the stiffness of the resin base. Furthermore, this injury appears to be permanent.

Surface and Discoloration.—Examination of the surfaces of specimens after the transverse tests, both while wet and after drying, revealed that, with the exceptions noted below, they were smooth to the touch although no longer flat as they were when first formed against the plates of glass. The hardened Tri-Tex yielded a somewhat pebbly or grainy surface which might not be objectionable. A lining of Permadent, immersed in distilled water for four hours, tested in transverse bending and then dried in air at room temperature, had a surface like that of the other materials. When this material was kept in water for a week or a month prior to testing, the surface became heavily wrinkled, and, on drying, the Permadent not only retained the wrinkles but turned white and opaque. The half disks shown in Figure 4 also illustrate the surfaces obtained.

The effect of time after application of the liner may be seen in Figure 8. These specimens were illuminated to bring out any crazing of the base resin. The four-hour specimens showed little, if any, crazing; the specimens one week and one month old showed progressively more for most of the liners. Some of the liners turned grayish white and opaque on long immersion.

Hardness. — Tests indicate that the hardness of methyl methacrylate resin is dependent on temperature. The variation on uncoated Plexiglas was from 16.5 K.H.N. (Knoop Hardness Number)[6] at 21°C. (70°F.) to 12.1 K.H.N. at 29°C. (84°F.). From this, it is evident that the temperature must be known if hardness numbers of methyl and methacrylate resin are to be significant.

On tests of resin and liners (solvent-resin type) made at the same time and temperature, the liners were 7.5 to 9 K.H.N. softer than the resin. These values represent hardness determinations for reliners aged as much as a month and a half. The plasticized resin type of liner, as represented by Permadent, was extremely soft (probably less than 2 K.H.N.) even after storage in water for one month.

Observations of Practicing Dentists

In the interest of comparing laboratory results with clinical experience, the following questionnaire was sent to fifty prosthodontists throughout the country:

Clinical Report on Denture Reliners

1. Have you used any of these materials?
Yes..... No.....
If "yes," list trade names.....
.....

If you have not used these reliners but have had relined cases referred to you, please answer the following questions as far as possible:

2. Approximately how many cases have you relined? .....
Upper.... Lower.... Partial....

3. Were there any instances of irritation or burning of the mouth tissues? Yes.. No..
If "yes," give brief description, including duration.....
.....

4. In general, did an improved fit result?
(*a*) immediately: Yes....No....
(*b*) after 6 months: Yes....No....
(*c*) after...* months: Yes....No....

*Insert longest period of service in your practice.

6. Knoop, Frederick; Peters, C. G., and Emerson, W. B.: Sensitive Pyramidal-Diamond Tool for Indentation Measurements. J. Res. NBS 23:39, July 1939, RP 1220.

5. What effect has the reliner had on the base material?.....
.....

6. Was the surface of the relining material satisfactory?

(*a*) immediately: Yes....No....
(*b*) after 6 months: Yes....No....
(*c*) after...* months: Yes....No....

*Insert longest period of service in your practice.

7. If answer to 6 was "no," what was the difficulty?

(*a*) discoloration .....
(*b*) fouling.....
(*c*) cracking or checking.....
(*d*) peeling off.....
(*e*) other (describe).....

8. Was any disturbance in occlusion noted?

Yes..... No.....
If "yes," describe.....
.....

9. How many relined cases have you subsequently rebased or made over?.....
If any, give reason.....

10. From your experience would you rate these products as (1) permanent relining material; (2) temporary, for use only in special case; (3) unsatisfactory as a lining material.

(1)..... (2)..... (3).....

Check your rating.

Name .....
Address .....

In our report your name will not be identified with your comment.

Sixty per cent of the men replied, an unusually high percentage. Their replies cover more than 300 cases that have been relined by twenty-one of the men. The cases included: upper (36 per cent), lower (53 per cent) and partial (11 per cent) dentures.

Of those replying to question 3, 88 per cent reported the presence, of short duration, of irritation or burning of the mouth tissues. One reported two cases requiring two weeks to heal.

Opinion was unanimous that an improved fit resulted immediately after relining but was evenly divided regarding satisfactoriness of fit after six months or more.

Sixty-three per cent noted no effect of the liner on the denture base material, but the remainder reported "warpage," "softening and discoloration," "decomposition of the denture base," "blanching" and "disintegration of acrylic resin."

In response to question 6, 78 per cent thought the surface of the liner was satisfactory immediately after application, but 85 per cent reported the surface unsatisfactory after six months or more. The reasons given (question 7) for dissatisfaction were divided as follows: (*a*) discoloration, 23 per cent; (*b*) fouling, 23 per cent; (*c*) cracking or checking, 18 per cent; (*d*) peeling off, 28 per cent, and (*e*) bubbles, 8 per cent. Forty-two per cent of those answering this question reported failure of the surface due to all four of the causes listed on the questionnaire.

Opinion concerning disturbance in occlusion resulting from application of a reliner (question 8) was evenly divided, half of the replies claiming that the application of the liner had no effect while the other half noted a disturbance.

In response to question 9, the men, with a single exception, reported that all of these cases either have been or will be rebased or remade.

The experiences of the dentists who have reported on these liners have led them to classify the materials as: temporary, 17; permanent, 1; entirely unsatisfactory, 8.

Price Comparison

The Research Commission of the American Dental Association has not hesitated to make comparisons between the prices of ingredients and the price of a packaged material containing those ingredients when there appeared to be no special skill or treatment necessary in producing the packaged material.

Table 4.--Cost of Ingredients*

Liner	Net Weight	Retail Price Per Package	Cost of Ingredients Per Tube Based on		Retail Price Per 100 Gm.	Cost Per 100 Gm.	
	Gm.		Reagent Grade†	Commercial Grade‡		Reagent	Commercial
Dr. Craig's	47.3	$5.00	$0.05	$0.04	$10.56	$0.11	$0.08
Fink	63.6	8.00	0.33	0.06	12.57	0.51	0.10
Getz--400	52.4	8.00	0.11	0.06	15.25	0.21	0.12
Permadent	113.4	8.00	0.22	0.12	7.05	0.20	0.11
Stardent	64.5	8.00	0.13	0.08	12.39	0.21	0.12
Tri-Tex powder	101.9	15.00	0.33	0.21	9.08	0.20	0.13
liquid	63.4						

*Using market prices of chemicals as of April, 1945.
†Sold in glass bottles up to 3 kg. per bottle.
‡Sold in less than carload lots, or drums where quoted.

More particularly has the Commission been interested in those cases in which there seemed to be an excessive mark-up in retail price,[7] and it has requested that analyses be made and price comparisons set up. Table 4 shows the retail prices of packaged liners and the corresponding cost of the ingredients based on our chemical analyses. Two sources were used for the costs of the ingredients; one, a catalog[8] of reagent grade materials which are sold in quantities of one, two and three kilograms to the package; the other, a list of commercial chemical prices.[9] In the case of the latter, the price selected was that listed for less than carload lots, or for drums when available. The first five columns of the table list, respectively, the trade name of the liner, the net weight of the contents, the retail market price per package and the costs of the ingredients computed from the reagent catalog prices and from the commercial price listings. Columns 6, 7 and 8 are the retail market price and the cost of ingredients from columns 3, 4 and 5 computed for 100 gm. of each liner.

From these figures, one may see that the cost of resin and solvent may vary from 3.7 cents to 33.2 cents for packages of materials that retail for from $5 to $15. Figures are not available on the cost of packaging (containers, instructions, etc.), labor, overhead or profit. However, tooth paste is sold in equivalent packages for 35 to 50 cents retail.

Conclusion

The use of currently available liners for dentures has definite adverse effects on the base resin of the denture. The liners tend to distort, weaken and soften the denture base resin. The liner itself is softer than the base resin and, in many instances, on prolonged immersion in water, crazes and turns white or opaque.

Although the use of liners will yield a temporary improvement in the fit of loose dentures, liners should certainly not be called permanent, nor do they yield results comparable to an efficient rebase. The experience of practicing dentists completely supports these conclusions based on laboratory tests.

7. Paffenbarger, G. C., and Beall, J. R.: An Investigation of Four Gypsum Model Materials Used to Prepare Indirect Inlay Models. J.A.D.A. 25:1146, July 1938.

8. Eastman Organic Chemicals, List No. 34. General Sales Division, Eastman Kodak Co., 1944.

9. Oil, Paint and Drug Reporter, May 1945. Schnell Publishing Co., Inc.

It is possible that improved technic in application of the liners and, more particularly, in elimination of the solvent or plasticizer might result in less damage to the resin of the denture. With current materials used as directed, the profession is paying an exorbitant price for a product of questionable utility.

THE NORMAL AND THE ABNORMAL LABIAL FRENUM: CLINICAL DIFFERENTIATION

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No one doubts that an authentic abnormal frenum is able to maintain a separation of the upper central incisors. Nevertheless, there is considerable misunderstanding as to just what constitutes the genuine, but rare abnormal frenum as opposed to the harmless, though common, enlarged variation of the normal frenum. The confusing similarity between the two has resulted all too often in faulty diagnosis, and an enlarged frenum has been committed prematurely or erroneously to surgical resection.

Few attempts have been made in dental literature to provide a detailed description of the frenum in any of its deviations from the normal. Instead, isolated comments have been made by many individual writers, adding to the confusion with widely varying opinions. Adequate attention has rarely been given to the favorable processes of normal development as represented by the eruption of permanent teeth other than the central incisors and by a natural inclination of the frenum to degenerate with age. Observe, for example, that separation of the central incisors is a fairly normal characteristic of early developing dentures, and, additionally, that most of the frenums considered abnormal are found in children. Recall also the relative absence of separation of the central incisors in adults in comparison with the frequency of the condition as observed in children. Surely not all of these adults have at one time or another had the frenum resected; nor is it very likely that any great number of them had orthodontic treatment during childhood, since many of them still have a marked malocclusion of the teeth. More likely, the midline spaces most of these adults undoubtedly had as a normal characteristic during early life simply closed naturally as a result of the eruption of other permanent teeth.

In itself, the frenum gives further evidence that it is not necessarily the cause of separation of the central incisors. Thus, there are cases of enlarged frenums with contacting central incisors; other cases of separated central incisors with normal frenums, and cases of enlarged frenums with contacting central incisors, but with spaces on either side of the lateral incisors.[1] The most convincing evidence is furnished in still other cases of enlargement of the frenum and separation of the central incisors before the eruption of the lateral incisors, but with normality of the frenum and contacting relations of the central incisors after their eruption. Since the resection theory does not apply to any of these conditions, it does not necessarily

1. Tait, C. H.: Median Fraenum of Upper Lip and Its Influence on Spacing of Upper Central Incisor Teeth. New Zealand D. J. 25:116, September 1929.

apply to those cases under discussion that persistently present both an enlargement of the frenum and a separation. Such a frenum almost invariably is simply an associated structure which exists because of other conditions. Surgical resection in itself, moreover, will not result in closure of the space until these conditions are discovered and eliminated; and, with their discovery and correction, resection will no longer be necessary.

Furthermore, it is not necessary that these etiologic conditions be either pathologic or abnormal. They may just as readily be developmental. This is true because the ultimate size and position of the frenum depends for the most part on the normal development of the adjacent dental and premaxillary structures. For this reason, careful diagnosis requires that no frenum be resected without allowing adequate time to elapse between the first examination and the final decision. Observation should extend at least over a period of months to determine whether the natural forces of growth and development are not sufficient to close the space in a normal manner. Ultimately, it will be observed that this process is the rule rather than the exception.

Development of the Normal Frenum

A study of the development of the frenum is revealing in attempting, in children, to determine its future growth. Little recognized is the fact that, early in fetal life, it arises as a relatively massive structure. (Fig. 1.) It is so extensive that it actually seems to create a cleft in the developing alveolar ridge, thus apparently dividing the dental arch into two lateral portions.[2] At this time, moreover, it has a distinct and almost continuous attachment to the palatine papilla, the oval tuft of tissue located later in life in the interproximal area immediately adjacent to the central incisors lingually. However, recessive tendencies that are characteristic of the structure throughout its life soon begin to operate. Alveolar growth exceeds that of the frenum in downward and forward development, with the result that, by birth, the frenum has been expelled outward to superficial attachment on the crest of a now continuous alveolar arch. Although smaller, it may still appear to be united with the papilla. It usually retains this position until eruption of the teeth.

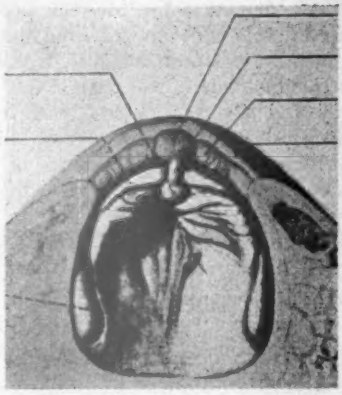

Fig. 1.—Frenum in fetus at three months, showing size and position, manner in which it seems to divide alveolar process into two lateral portions and attachment to palatine papilla, with which it appears to be continuous. (From Orban's Oral Histology and Embryology.)

The recessive developmental tendencies of the frenum resume their activity with the appearance of the deciduous incisors. As these teeth erupt, there is a further increase in the vertical dimension of the alveolar structures. Normally, this downward development creates a division between the frenum and the papilla, after which the frenum is left at a higher point of attachment in relation to the alveolar crest. Thus, it is possible that the attachment does

2. Orban, Balint: Oral Histology and Embryology. St. Louis: C. V. Mosby Co., 1944, p. 26.

not rise, but that the alveolar process simply develops downward from the attachment. It is not necessarily true that the frenum remains stationary while the teeth and alveolar process pass it in downward growth. It is more likely that the recessive characteristics of the frenum again become active, with the result that it once more tends to diminish in size as further alveolar and dental development occurs.

With the eruption of the permanent central incisors, the arches enter into another period of growth acceleration. If there has been no interruption in the atrophy of the frenum up to this point, the structure will now assume a normal position and attachment well above the interproximal gum tissue. Certain conditions may encourage it to retain an inferior attachment with or approximating the palatine papilla. Since alveolar development ordinarily occurs somewhat in advance of dental eruption, previous separation of the deciduous incisors has normally produced the so-called developmental spaces for the larger permanent teeth. It must also be remembered that upper central incisors, unlike other teeth, develop in crypts separated by a well-defined bony suture. Of necessity, they erupt with a space between them. All of these processes favor the existence of the frenum. Therefore, an enlarged low-attached variation of the normal frenum, if still present after the eruption of the permanent central incisors, will not now degenerate until activated to do so by the subsequent eruption of the lateral incisors and cuspids. The force produced in this process is of a wedging nature and, in connection with the frenum, has been termed pressure atrophy.

Herein lie the reasons for caution in resection during early childhood; that is, prior to eruption of the permanent lateral incisors and cuspids. These teeth contribute to the lateral halves of the arches the additional dental units necessary to complete the arch and to secure contacting relations between the central incisors. Each lateral incisor, as it erupts, is thrust into the space between the adjacent central incisor and deciduous cuspid. If the central incisors are separated, the eruption of the two lateral incisors, backed up by the deciduous cuspids, results in a wedging action on the central incisors that normally brings the latter teeth into contact. This is Nature's method and intent. If an enlarged frenum with a low attachment has persisted up to this stage, this wedging action will usually exert the pressure necessary to cause it to atrophy and thereafter assume its normal proportions.

After they have erupted, the lateral incisors, as may be observed, particularly in roentgenograms, have a definite distal inclination with noticeably diverging crowns, so much so that they fail to come into contact with the central incisors. This condition, which is within the range of normal variation, is caused by the proximity of the developing cuspid crowns to the roots of the lateral incisors. As the cuspids erupt, the lateral roots migrate into the area formerly occupied by the cuspid crowns. In this manner, the fan-shaped divergence of the lateral incisors is reduced and they assume a more vertical position, and the lateral crowns move into contact with the central incisors. The eruption of the cuspids thereafter causes contact among all of the anterior teeth by providing the necessary tooth structure to complete the arch. Consequently, what may appear to be an abnormal frenum with separated central incisors at the age of 6 will become a normal frenum with contacting central incisors at the age of 12. This atrophy of the frenum, although not so rapid as during the early ages, often continues throughout life so that, in a few persons past

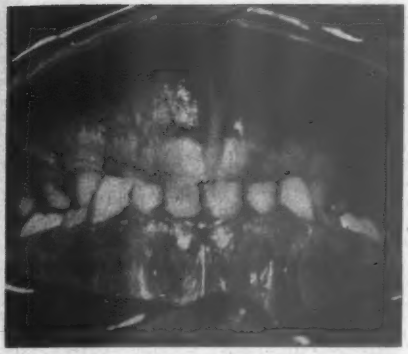

Fig. 2.—First of series of five photographs illustrating progressive atrophy of frenum. At the age of 6, the patient presented a Class III malocclusion with an associated simple enlargement of the frenum that could easily have been mistaken for an authentic abnormality.

middle age, the structure can be detected only with difficulty.

Factors in Variations of the Normal Frenum

In this discussion, a distinction is made between the normal, although enlarged frenum and the frenum that has definite abnormal characteristics. The point is stressed that a truly abnormal frenum is rare and must not be confused with the frequently recurring enlarged frenum that either has not had the time to atrophy or persists because of other conditions present. In making these observations, it must be remembered that, in both of these conditions, there is an associated disturbance in growth and development throughout the entire premaxillary area. Careful thought, therefore, must be given to the possibility that an enlargement of the frenum, instead of being the cause of separation of the central incisors, might actually be the result of such a separation. This is true because the very presence of separated central incisors from any cause favors the continued existence of the frenum. It is, moreover, characteristic of any anatomic structure to guard its rights of position and existence. Thus, a simple enlarged frenum has a tendency to exert passive resistance to the forces attempting to eliminate it. Its success is dependent for the most part on other conditions.

Arch form, for example, may be abnormal, so much so that the lateral incisors and cuspids are prevented from producing sufficient mesial pressure on the central incisors to close the space in a normal manner. In early developmental stages, the lateral incisors are located slightly lingually from the central incisors and cuspids, and they may erupt in that position in an underdeveloped arch; or, because of their size, they may readily be deflected labially, if arch form otherwise is abnormal. Even under more favorable conditions, too much dependence cannot be placed on the lateral incisors in producing the wedging action. The central incisors are larger teeth than the lateral incisors and, therefore, in themselves, present resistance to displacement greater than that supplied by the lateral incisors. If lost prematurely, the deciduous cuspids fail to reinforce the lateral incisors as they

Fig. 3.—Frenum with low attachment extending into interproximal gum septum. The separation between the deciduous central incisors is not so great as that between the right central and the right lateral incisor. (Compare Fig. 2.)

Fig. 4.—Case shown in Figure 2, after ten months of orthodontic treatment. Correction of the Class III irregularity is well underway, but the permanent central incisors have erupted with a wide space between them. An increase in vertical height of the alveolar structures is evident. The inferior attachment of the frenum is now well above the crest of the alveolar ridge.

erupt. The lateral incisors instead drift distally.

Both the lateral incisors and the cuspids tend to erupt mesially, but the cuspids are larger teeth and therefore exert a more powerful influence. Nevertheless, they erupt at a much later developmental period after malocclusion, if present, has entered a more pronounced stage. As a result, they may be displaced labially or lingually or they may be completely impacted. In none of these positions can they perform their normal function. Thus, any resulting enlargement probably would not be an authentic abnormal frenum. The space would fail to close after its removal, and a further search would have to be made for the actual cause.

None of these irregularities is present in the normal development of well-formed arches. Atrophy of any enlargement of the frenum can be expected to take place naturally with normal eruption of the teeth. Malocclusion associated with separation of the central incisors should be treated as an orthodontic condition. Ordinarily, restoration of normal occlusion will release whatever developmental forces are necessary for atrophy of the frenum and closure of the space. (Figs. 2-6.)

Unfavorable Factors in Resection

Prior to resection, consideration must be given to the undesirable effects of surgical operations, the most important of which is formation of scar tissue between the central incisors. Scar tissue offers greater resistance to teeth attempting to come into contact, whether by natural processes or by orthodontic means, than does the usual simple enlarged frenum. It may always act as a barrier to proper midline contacting relations, particularly if the space is not closed promptly after the operation.

Also of importance is the relation that the transseptal fibers of the periodontal membrane have to the retention of the central incisors after they have been brought into contact. These fibers extend across the crest of the interdental bone from the cementum of one central incisor to the cementum of the other. Their function is to bind teeth together and to support the interproximal gum

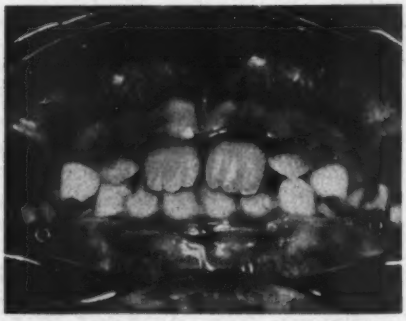

Fig. 5.—Further atrophy of the frenum following another five and one-half months of treatment and of normal alveolar development. This photograph, and the one in Figure 6, provide an excellent example of the wedging action of the lateral incisors in producing mesial movement of the central incisors. Later, eruption of the cuspids will promote contact of all the anterior teeth.

Fig. 6.—Condition nine months later (compare Fig. 2), or twenty-four months after the original pictures were taken. There is now no evidence of enlargement of the frenum; the alveolar attachment has assumed a normal position, and no trace remains of the original Class III malocclusion. All conditions are favorable for future normal dental development.

tissue. Surgical removal of the frenum involves the danger of severing these normally attached and interlacing fibers of the periodontal membrane, so necessary to physiologic retention after contacting relations have been established between the central incisors.

The most convincing reason for opposing surgical resection is that, in nearly all cases, it is not necessary. Left alone, the space would have closed anyway. It may, moreover, have even a better chance of closing and of staying closed in the absence of surgical operations.

The Normal Frenum and Its Variations

The normal appearance of the frenum at maturity is that of a thin, triangular, knife-edge fold of mucous membrane which has a relatively wide origin on the inner surface of the upper lip, extends posteriorly to a midline attachment on the labial aspect of the alveolar process and terminates at a point 4 or 5 mm. above the interproximal gum septum between the central incisors. Beneath its lower attachment, the gingival tissues appear to be continuous.

The frenum is composed almost entirely of a highly vascular white fibrous connective tissue covered superficially with stratified squamous epithelium. In the center of the structure, the fibers are somewhat regular in arrangement with the strands running anteroposteriorly. At the anterior extremity, they merge loosely with the fibers of the submucosa of the lip. At the midline alveolar insertion, they blend with the fibers of the outer layer of the mucoperiosteum and the connective tissue overlying the median suture. There are no muscular fibers in the frenum. Although it has no known function, it is fully able to adapt itself to any of the normal movements of the lip, with little change in form.

As with any other anatomic structure, the normal frenum is subject to certain recurring variations in form, size and position. Some frenums are broad and sturdy; others are thin and pliable. These variations may be seen not only in the same child at different ages, but also in different children of the same age.[3] It is in the first of these that the frenum demonstrates its recessive tendency to diminish in size as it increases in age; while the second illustrates the difficulty of diagnosis and treatment in any child, since development throughout the denture may be retarded in certain children, while perfectly normal in others of the same age. Therefore, since the frenum is known to be broader and coarser in children than in adults, any diagnosis in the early ages is bound to be questionable and unreliable if based on one examination only.

Other variations of a relatively minor nature may be seen from time to time. One is the presence of a small nodule attached superficially near the crest of the structure. It is not constant in size or position, nor is it associated with any

3. Coleman, R. E.: Study of Frenum Labii Superioris. Sch. of Dent. Alum. Bull. U. Mich. 42:17, June 1941.

Fig. 7.—Separation of anterior teeth. This is usually the result of any increase in the size of the dental arch. In this Class II case, the separation was confined to the area between the central incisors, but it had nothing to do with the enlargement of the frenum. The space existed simply because there was no equivalent increase in the mesiodistal diameters of the six anterior teeth to compensate for the increase in size of the arch.

particular type of frenum. Occasionally, the frenum presents a double effect by bifurcating vertically into two definite folds of tissue separated by a channel or groove little more than 1 mm. in width. Nodules on this type of frenum are found in one side of the channel only.

At certain periods during early development, the frenum may be located in a vertical concavity formed between the roots of the erupting central incisors. This need give no concern. It is simply further evidence of accelerated downward growth of the alveolar process during a period of active dental development. The presence of the frenum has not been known to cause a separation of the maxillary bones by penetration of the maxillary suture.[4] The frenum and the suture apparently have little or no relation to each other. Roentgenograms show that the suture may be as widely separated in the presence of a normal frenum with contacting central incisors as with an enlarged frenum and separated central incisors. Conversely, the suture may be closed entirely in the presence of separated central incisors.

In contrast to the frenum, the palatine papilla is a stable landmark. It shows little change in size or position from its earliest appearance, through the various stages of alveolar development, and on into maturity. Perhaps its only variation is a labial extension that appears occasionally between the erupting central incisors. Atrophy occurs as eruption proceeds, with no trace remaining in the adult denture.

None of these variations is serious. They are simply modifications to be observed from time to time, but which in themselves have no detrimental effect on the teeth.

Actual Causes of Separation of the Central Incisors

It may be stated as a purely mechanical principle that spaces will develop between the incisors as the result of any condition which requires the six anterior teeth to occupy an arch larger than they were designed to fill, because there is no equivalent increase in the mesiodistal dimensions of these teeth to compensate for the increase in the size of

Fig. 8.—Correction of malocclusion resulting in reduction in size of arch, contact of central incisors and atrophy of enlarged frenum. (Compare Fig. 7.)

4. Ketcham, A. H.: Frenum Labium and Its Relation to Intermaxillary Suture. Am. Orthodontist 1:36, June 1907.

Fig. 9.—Separation that superficial diagnosis could easily and erroneously attribute to abnormality of frenum. A persistent tongue thrust was the actual cause of the diastema and of the associated open bite. The frenum failed to atrophy because pressure stimulation ordinarily supplied by central incisors in moving into contact during normal development was lacking.

the arch. Reference is made to anterior teeth that drift labially into a position of undue prominence. Under these conditions, an enlarged frenum may persist as a result, but not as a cause, of the separation. (Figs. 7-8.) The exception to the rule occurs when the posterior teeth also migrate forward sufficiently to maintain contacting relations in the anterior segment of the arch.

Habits are a frequent cause of this malformation. The tongue, habitually or during the act of swallowing, may be thrust against the upper anterior teeth with such force and persistency that the incisors are carried forward into a larger arch than they were intended to occupy. (Figs. 9-10.) Obviously, they will lose contact in the process. Abnormal tongue positions in related speech anomalies may also be an etiologic factor. There is a similar reaction from thumb or finger pressure on the inside of the upper arch.

Lip habits also may lead to separation of the anterior teeth by causing an increase in the size of the arch. (Figs. 11-12.) In Class II, Division 1, malocclusion, the upper anterior teeth are not only in labioversion, but are also labially inclined. Normal muscular function is difficult in this type of malocclusion. These cases present a characteristically short, underdeveloped upper lip and a full lower lip that folds in behind the upper incisor teeth. Lack of function of the upper lip permits the upper incisors to drift labially. The increase in size of the lower lip actually encourages them to do so.[5] In this manner, there is created a larger cuspid-to-cuspid arc than is normal for the upper arch.

A closed bite may produce a similar separation of the anterior teeth. (Figs. 13-14.) In these cases, the lower incisors occlude with the upper incisors at the cingulum, an area that has a greater diameter labiolingually than at the incisal edges, where the opposing teeth normally come into occlusal contact. This occlusal relation often results in forcing the upper incisors forward into a position of labial inclination, with resultant spacing of the anterior teeth.

The principle is the same when the lateral incisors are peg-shaped or congenitally absent, except that, in these cases, the condition is caused by a de-

5. Dewel, B. F.: Dentofacial Musculature. Am. J. Orthodontics 25:469, September 1941.

Fig. 10.—Correction of habit (compare Fig. 9) and of malocclusion resulting in normal contact relations between central incisors and atrophy of frenum without resort to operation.

Fig. 11.—Separation in which abnormal lip pressure was only cause of condition.

ficiency of normal tooth material rather than by an increase in size of the arch. A midline space results because no support is provided for the distal surfaces of the central incisors. Instead, these teeth are permitted to drift to any position dictated by action of the lips, the tongue or the lower incisors.

If a peg-shaped lateral incisor is at fault, a porcelain jacket crown is probably the best means of maintaining contact after the central incisors have been brought together. If the lateral incisors are missing, two methods of approach are available, the choice depending on the individual case. One is to supply artificial teeth. The other, and probably the better, is to close the space by directing the cuspids into the positions ordinarily held by the lateral incisors and by moving the upper molars and bicuspids mesially into what is in effect a Class II relationship with their mandibular opponents.

Fig. 12.—Case shown in Figure 11, after treatment. Correction involved primarily the restoration of normal muscular function. The central incisors were brought into contact by correcting their axial inclination, moving them lingually as well as mesially, and by restoring the arch to normal size.

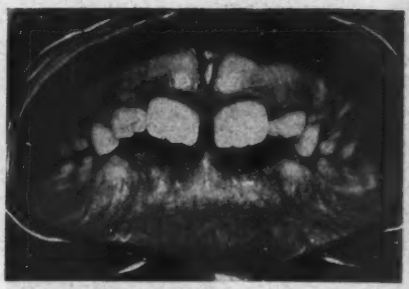

Fig. 13.—Frenum that failed to receive sufficient stimulation, ordinarily provided by contacting central incisors, to atrophy. In this case, the cause of the separation was a closed bite and a resulting increase in size of the dental arch.

The simplest cause of spacing involving malocclusion is crowding, oversize or rotation of the lower incisor teeth. Thus, when the jaws are closed, a lower central incisor in labial malposition may occlude directly in the area where the upper incisors should come into proximal contact.

In any of these conditions, the resultant spaces may be confined to the area between the central incisors and therefore be easily attributed to the

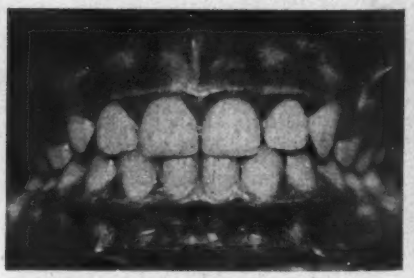

Fig. 14.—Correction of malocclusion resulting in pressure atrophy of threadlike frenum and in normal incisal relations of anterior teeth.

Fig. 15.—Wide separation in almost complete absence of frenum. The cause of the separation was closed bite. The case is of interest in comparison with a practically identical condition in the next series, in which an enlarged frenum had been involved.

presence of a questionable frenum. A simple enlargement has nothing whatever to do with the separation. The frenum persists simply because teeth in such forms of malocclusion fail to exert sufficient pressure to cause it to atrophy. Surgical resection can hardly be the proper solution. It will, of course, eliminate the objectionable tissue, but the space will exist as long as the actual cause is present, just as it does in those nearly identical cases of perfectly normal frenums. (Figs. 15-18.)

Diagnostic Symptoms of Authentic Abnormality of the Frenum

Although abnormal frenums are not

Fig. 16.—Midline contacting relations and normal occlusion restored by routine orthodontic treatment of closed bite and labial inclination of central incisors.

Fig. 17.—Enlargement of frenum erroneously diagnosed as cause of separation a year or more before orthodontic consultation. The space failed to close after resection because the actual cause, as with the case in Figure 15, was a closed bite.

so common as has been assumed in the past, it is still necessary to recognize them when they do appear, even though it be, on the average, no more often than once in a decade. If present, an indisputable abnormal frenum is found to be markedly enlarged, retaining in exaggerated form most of the coarsened and thickened characteristics of its earliest developmental stages. It presents a wide fan-shaped attachment to the upper lip,

Fig. 18.—Case shown in Figure 17 a year or more after removal of retainers, following orthodontic treatment. It is to be noted that the interproximal gum tissue fails to project gingivally between the central incisors, the teeth are still slightly separated and traces of scar tissue can still be seen along the median line.

Fig. 19.—Frenum, in child of 4, showing definite abnormal tendencies. It is to be observed at three-month intervals to determine future developmental changes. It probably presents an authentic abnormality and may require surgical resection.

which tapers downward to a distinct sheetlike process extending between the central incisors to a definite union with the palatine papilla. (Fig. 19.) As a further diagnostic symptom of importance, a truly abnormal frenum seems to become more pronounced as it increases in age, whereas a simple enlargement ordinarily becomes less evident with the passing of time.

In the development of the frenum, it is possible that the fibers uniting it and the papilla fail to separate properly as the deciduous teeth erupt. If this is true, it is further possible that, with such a rigid interlocking attachment, the frenum is simply carried along in downward and forward growth at the same rate and to the same extent as the alveolar structures. Such growth, of course, produces a frenum fully able to maintain a separation of the central incisors.

In examining any frenum, the extent and location of the alveolar attachment can best be observed by distending the upper lip outward and upward. If this tension, applied intermittently, produces blanching and a definite amount of movement not only of the tissues between the central incisors but also of the palatine papilla, the frenum may be considered abnormal, provided it can be traced distinctly as a continuous structure, that sufficient time has elapsed for normal developmental forces to assert themselves and that all other possible causes of the separation have previously been eliminated.

—Even with the present available knowledge, it is occasionally difficult to distinguish between a simple enlarged frenum and an authentic abnormal labial frenum. For this reason, many frenums actually within the range of normal deviation have been subjected needlessly to surgical resection. Proponents of "surgery first" apparently believe that, regardless of age, resection is of no concern since it is a short and only moderately complicated procedure.[6, 7] Little attention is paid to the danger of scar tissue or possible damage to the transseptal fibers of the periodontal membrane. Also ignored is the fact that most of these cases are either self-corrective or readily responsive to proper physiologic pressure as applied orthodontically. On the other hand, some observers seem to question the presence under any circumstances of an abnormal frenum that requires surgical resection.[6, 8] The true concept probably lies somewhere between these two extremes.

Appliance Considerations

Whether a questionable frenum is to be eliminated by surgical resection or by pressure atrophy, some type of appliance is almost invariably required to close the space. With surgical elimination of an authentic abnormal frenum, the appli-

6. Dewey, Martin; Johnson, A. L., and Mershon, J. V.: Individual Responses to Questionnaire on Maxillary Labial Frenum. Internat. J. Orthodontia 19:450, April 1933.

7. Kelsey, H. E.: When Is Frenum Labium a Problem in Orthodontics? Am. J. Orthodontics 25:124, February 1939.

8. Taylor, J. E.: Clinical Observations Relating to Normal and Abnormal Frenum Labii Superioris. Am. J. Orthodontics 25:464, July 1939.

ance is necessary in order to limit scar tissue formation by closing the space promptly. If the result can be accomplished without surgical interference, the appliance is necessary to cause the frenum to atrophy under a stimulation comparable to natural physiologic pressure.

If, ultimately, the course required is that of surgery, radical removal should rarely be attempted. It should be undertaken only as a local correction, and should not extend into the tissues of the lip or into the periodontal membrane. A small triangular section beginning at a point 3 or 4 mm. above the central incisors and extending downward to include the palatine papilla is the part that does the damage and is, therefore, the only part that should be removed.[9]

Since prior employment of appliances will be necessary if resection is required, the most acceptable approach is an attempt to close the space by moderate orthodontic means. If tissue hypertrophy instead of pressure atrophy results, convincing evidence is finally obtained for a diagnosis of a true abnormality of the frenum. The central incisors may then be permitted to drift apart, almost but not fully to their original positions, after which the offending tissues may be carefully resected, either by surgical operation or by use of the cautery. With orthodontic appliances already in place, a mechanism is present to close the space quickly, before the formation of postoperative scar tissue.

Summary

1. The frenum presents two different, but confusing deviations from the normal. One is a simple, harmless enlargement; the other is a true abnormality. Of these, the former is by far the more common.

2. No frenum should be considered abnormal until every conceivable cause of a separation of the central incisors has been eliminated. These conditions are more often developmental than pathologic.

3. The frenum develops in the fetus as a comparatively massive structure. Thereafter, it is characterized by persistent recessive developmental tendencies until, in the adult, it resembles a relatively insignificant fold of tissue.

4. Central incisors develop in crypts separated by the maxillary suture. Of necessity, they erupt with a space between them. Subsequent eruption of the lateral incisors and cuspids provides the pressure necessary to carry the central incisors into contact and to cause atrophy of the frenum, if it has maintained a low alveolar attachment. It is in these immature transitional periods that a simple enlargement most frequently is confused with an authentic abnormality.

5. The protracted presence of separated central incisors from any cause favors the continued existence of an enlarged frenum. Abnormal tongue pressure, lip habits, the absence of lateral incisors or the presence of peg-shaped lateral incisors and certain forms of malocclusion are among the causes of separation of the central incisors.

6. Resection of the frenum provides no assurance that the central incisors will move into contact. It will eliminate the objectionable tissue, but the space will remain as long as the actual cause is present.

7. In doubtful cases, orthodontic appliances should be placed to close the space in part before surgical interference is undertaken. Usually, the space can be closed completely without resection. If surgical measures are necessary, appliances are already in place to move the central incisors into contact promptly, before scar tissue can form.

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9. Anderson, G. M.: 'Surgical Removal of Abnormal Maxillary Frenum. Orthodontia Rev. 1:60, March-April 1933.

MEDICAL AND DENTAL CARE IN PREPAYMENT MEDICAL CARE ORGANIZATIONS

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Although the dental profession has long been aware of the relation between oral health and general physical well-being, the public has been slow to recognize the importance of dentistry in safeguarding general health. Dentists, in appraising the extent of the nation's unmet dental needs, have been fully conscious of the barriers to effective utilization of dental science and technics — ignorance of the value of dentistry, fear of pain and costs of services. The high proportion of young men rejected from selective service because of dental defects has awakened the country to greater appreciation of the importance of dental health, while educational measures have reduced the barriers of ignorance and fear. For the majority, however, the problem of costs as yet remains unsolved.

The same problems in meeting the expenses of medical care have been approached by spreading costs over large groups of people. Some fifteen years ago, the prepayment method of meeting costs of hospital care was initiated in this country, and its success is indicated by the fact that in 1945 more than 18 million persons were entitled to hospital care on a prepayment basis through Blue Cross plans. A similar arrangement for meeting the costs of other medical services was long restricted to certain areas and employe groups, but in recent years there has been an increase both in the number of organizations providing medical care on a prepayment basis and in the number of persons entitled to their services.

Prompted by interest and concern in any measures for distributing dental costs and making dental care more widely available, the dental profession has undertaken a study of existing prepayment plans for medical and hospital services to evaluate the possibility of developing similar plans for providing dental service. As a result of its study, the Council on Dental Health of the American Dental Association recommended early this year that "experimental dental service prepayment plans be inaugurated under the direction or supervision of component dental societies."[1] A step already has been taken in this direction. In Maryland, through the efforts of the Medical and Chirurgical Faculty and the State Dental Association, it is now legally possible to establish a non-profit prepayment dental care plan. The Maryland State Dental Association and the Blue Cross are now considering a dental program, limited for the time being to children whose families subscribe to Blue Cross. Adults are excluded because of the insufficiency of professional personnel and the backlog of services required for the adult group.

A report by the Bureau of Research and Statistics of the Social Security Board[2] may be of interest to the dentists who are working on the specifications of a dental prepayment plan. The study gives information on 229 prepayment

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1. Recommendations for Experimental Prepayment Dental Plan. J.A.D.A. 32: 195, February 1, 1945.

2. Klem, Margaret C.: Prepayment Medical Care Organizations. Ed. 3. Washington: U. S. Government Printing Office, 1945.

medical care organizations in the United States and sixteen in Canada. Of the 229 organizations in the United States, ninety-two provide some form of dental care on a prepayment or reduced-fee basis, and, of the 5 million persons eligible for prepaid medical services, about one-third were also entitled to the dental care provided by the plans. Information on the individual plans relates to 1945, in most instances to March and April of that year. A statistical summary also includes some information for 1943, obtained in an earlier study.[3] The report is limited to organizations which furnish or supervise medical services for subscribers and, in some instances, their dependents. Some of the plans also pay cash disability benefits to compensate for wage loss. The report does not cover commercial insurance, plans giving cash benefits or hospital care only or plans administered by the Farm Security Administration, which are usually limited to rehabilitation borrowers.

The medical care organizations are classified by type as follows: industrial, medical society, private group clinic, consumer-sponsored and governmental. Prepayment plans associated with industrial establishments, which are the most numerous, are financed by employers, by employes or by employers and employes jointly. The medical society plans have been organized by either state or county medical societies; services are furnished by private practitioners who have chosen to participate in the plan. The term "private group clinic" is used to designate organizations owned and managed by one or more physicians; the services are usually provided by the physicians practicing as a group. Consumer-sponsored plans are organized and directed by subscribers and somewhat resemble industrial plans organized and financed by employes. The governmental plans have been established by a federal, county or city governmental unit for its employes. Membership in organizations of this type is usually compulsory. The plans established for seasonal farm workers, domestic and foreign, recruited, transported, housed or placed by the War Food Administration or a cooperating agency, are financed entirely by federal funds.

Membership in Prepayment Medical Care Organizations

In 1945, about 5 million persons were eligible for care in the 229 organizations in the United States studied by the Bureau of Research and Statistics. Subscribers and their dependents were represented about equally in this total. Under some plans, dependents were entitled to services on a prepayment basis, while in others they were eligible for care from the organization's staff on a fee-for-service basis at fees ordinarily about half those usually charged by local physicians and dentists. The 2.6 million dependents eligible for care included those under both types of financial arrangements. Throughout the report, the number of persons referred to as eligible for care includes both subscribers and dependents, if service was available to the latter.

More than half the members of all plans belonged to organizations in only four states — California, Washington, Michigan and New York. The two states on the Pacific Coast, Washington and California, had one-third of the total membership in all plans. The distribution of membership in 1945 is shown in Table 1.

Membership in prepayment plans increased from 3.3 million in 1943 to nearly 5.0 million in 1945.[4] During this

3. Klem, Margaret C.: Prepayment Medical Care Organizations. Ed. 2. Washington: U. S. Government Printing Office, 1944.

4. For a summary of 1943 data, see Dental Service in Medical Prepayment Plans. J.A.D.A. 32:98-99, January 1, 1945.

Table 1.--Distribution of Membership in Prepayment Medical Care Organizations, 1945

Type of Organization	Number of Organizations	Members	
		Number	Per Cent of Total
Total	229	4,975,850	100.0
Industrial:			
Financed by employer	19	212,590	4.3
Financed jointly by employer and employe	47	546,772	11.0
Financed by employe	49	752,712	15.1
Medical society:			
Washington and Oregon	22	954,100	19.2
Other states	31	1,640,256	32.9
Private group clinic	21	406,330	8.2
Consumer sponsored:			
Financed partly by Department of Agriculture	5	23,553	0.5
Other	27	326,561	6.6
Governmental:			
War Food Administration and cooperating agencies	6	97,300	1.9
Other	2	15,602	0.3

period, membership was influenced by changes within the organizations themselves; for some plans consolidated with others, some passed out of existence and some were suspended temporarily. The 1945 membership reflects also the establishment of twenty-nine new plans with more than 458,000 members. Outstanding among the organizations with increases in enrollment were the medical society plans in Washington and Oregon, whose membership reached nearly a million in 1945—more than three times the number of members in 1943. Medical society plans in other states also showed a marked increase, from 742,000 in 1943 to 1,640,000 in 1945, or a gain of 121 per cent. This increase was not due primarily to the many new medical society plans recently established in these states, for the increased enrollment in plans in existence in the spring of 1943 accounted for more than 75 per cent of the increase in membership of all medical society plans outside Washington and Oregon.

Services Provided

Only a few prepayment medical care organizations provide comprehensive medical services including physicians' services in the office, home and hospital for medical, surgical and maternity cases; hospitalization; special nursing care; services of visiting nurses; dental care; roentgenogram and laboratory services; drugs and medicines. Usually, organizations limit their services to physicians' care in the office, home and hospital for medical and surgical cases (including, in many instances, maternity cases) and hospitalization.

About 3 million persons, or 60 per cent of all who were eligible for care through membership in the 229 organizations for which 1945 data are available, were entitled to receive physicians' care in the office, home and hospital for medical and surgical cases, except for certain excluded illnesses. At the other extreme, the only physicians' service available to about 23 per cent of the membership was care for surgical cases in the hospital, while an additional 11 per cent were eligible for care for both medical and surgical cases in the hospital. The 68,000 persons who were entitled to hospitalization only were dependents of subscribers eligible for more extensive medical services. The distribution of subscribers and dependents eligible for specified services in 1945 is shown in Table 2.

About 3.3 million of the 5 million

Table 2.--Distribution of Subscribers and Dependents Eligible for Specified Services, 1945

Type of Service	Persons Eligible	
	Number	Per Cent of Total
All persons	4,975,850	100.0
Physicians' services:		
At home and office and in hospital for:		
Medical and surgical cases	2,984,990	60.0
Medical cases only	38,141	0.8
At home and office only	203,459	4.1
In hospital only for:		
Medical and surgical cases	534,865	10.7
Surgical cases only	1,146,145	22.9
Hospitalization only	68,250	1.5

members of prepayment plans were entitled to hospitalization as one of the services provided, while most of the remaining 1.7 million probably also had hospitalization on a prepaid basis through contracts separate from those for other medical services. Separate hospitalization contracts are prevalent in medical society plans in states other than Washington and Oregon; many of the medical plans in these other states are sold through the Blue Cross business office, and membership in the Blue Cross is an eligibility requirement.

All persons covered by medical society plans in Washington and Oregon, by governmental plans and by consumer-sponsored plans financed partly by the Department of Agriculture were entitled to receive relatively comprehensive care; that is, the services of a physician for medical and surgical cases in the office, home and hospital, and hospitalization. This relatively complete service was available also to more than 83 per cent of the persons covered by each of the three types of industrial plans, to 76 per cent of those enrolled in private group clinics and to 52 per cent of those in consumer-sponsored plans, exclusive of plans financed partly by the Department of Agriculture.

Nearly all of the prepayment contracts of medical society plans in states other than Washington and Oregon covered only physicians' services to hospitalized patients; 66 per cent of their members were entitled to receive care only for surgical cases in the hospital; about 27 per cent were eligible for both medical and surgical care in the hospital, while only about 7 per cent could receive physicians' care in the office, home and hospital.

Dental Services Provided

Three out of every ten members of prepayment plans were entitled to some type of dental care, either on a prepayment or a reduced-fee basis. A few organizations provided fairly comprehensive dental services, including examinations, extractions, fillings, prophylaxis, roentgenograms, surgery and prosthetic work, but dental care was usually limited to one, two or three of these services. As a rule, dental care was provided on a prepayment basis through the prepayment medical care contract rather than at reduced fees. The organizations which provided prosthetic work usually made a separate charge for at least the cost of materials.

In 1945, the four types of dental care most frequently included in prepayment medical care services were roentgenograms, extractions, prophylaxis and fillings. An analysis of these services shows that the roentgenogram was the service most frequently available; more than

Table 3.--Percentage of Membership of Prepayment Medical Care Organizations Eligible for Dental Services, 1945

Type of Service	Per Cent Eligible for Service	
	Prepayment	Reduced Fee
Diagnostic x-ray	20.3	6.2
Extractions	13.1	5.5
Prophylaxis	5.4	4.9
Fillings	5.3	5.0

20 per cent of the total membership of all 229 plans were eligible for this service under the prepayment contract, and an additional 6 per cent could receive it for about half the fee usually charged in the locality. About 13 per cent of the total membership were eligible for extractions under their prepayment contracts, and an additional 6 per cent could receive this service on the payment of a reduced fee. Prophylaxis and fillings were available on a prepayment or a reduced-fee basis to a smaller proportion of the total membership (Table 3).

Many plans which provided roentgenograms as their only form of dental care gave this service as part of medical diagnosis. This accounts for the fact that a larger number of persons were entitled to receive this service than any other type of dental care.

Geographic Differences.—Regional variations are found in the extent to which dental service is provided by prepayment plans. The Pacific Region, for example, with about 36 per cent of the total membership in all prepayment medical care plans, had 62 per cent of those eligible for roentgenograms on a prepayment basis and 23 per cent of those eligible for this service at reduced fees, more than 50 per cent of those eligible for extractions on a prepayment basis and 22 per cent of those eligible for prepaid prophylaxis and fillings. This region had only a small proportion of the total membership eligible on a reduced-fee basis for extractions, prophylaxis and fillings (Table 4).

Less than 6 per cent of all members of prepayment plans belonged to organizations in the East South Central Region. Relatively few persons in this region, compared with the total in all regions, were eligible for roentgenograms and extractions on a prepayment basis, although slightly more than might have been expected were eligible for prophylaxis and fillings. This region was outstanding, however, in the provision of each of the four types of service on a reduced-fee basis. Of the total number of persons eligible for one or more of the four services at reduced fees, from 68 to 85 per cent were members of plans in the East South Central Region. This was due primarily to two large organizations in Alabama that provided the four services on a reduced-fee basis.

Although the East North Central Region contained 21 per cent of the total membership in all plans, it had only from 8 to 12 per cent of the persons eligible for one or more of the four dental services on a prepayment basis and an even smaller proportion of those eligible for dental care at reduced fees.

When the proportion of members eligible for dental service in each region is compared with the total membership in plans in the region (rather than with total membership throughout the country, as above), it appears that plan members in the East South Central area are more likely to receive dental service than those in other regions. More than 80 per cent of the persons belonging to plans in the East South Central Region were eligible for all four types of dental care, either on a prepayment or a reduced-fee

Table 4.—Number of Persons in Prepayment Medical Care Organizations Eligible for Specified Types of Dental Service and Percentage Distribution of Eligible Persons by Census Region, 1945*

Census Region	Diagnostic X-Ray		Extractions		Prophylaxis		Fillings	
	Prepayment	Reduced Fee	Prepayment	Reduced Fee	Prepayment	Reduced Fee	Prepayment	Reduced Fee
	Number Eligible							
Total	1,016,928	307,717	652,328	273,741	277,889	245,766	269,808	246,966
New England	605	3,986	605	3,986	605	3,986	---	3,986
Middle Atlantic	35,695	8,639	77,661	8,639	70,500	8,639	70,500	8,639
East North Central	118,241	8,427	86,172	8,427	30,350	8,427	21,850	8,427
West North Central	118,500	---	78,988	---	40,988	---	40,988	---
South Atlantic	40,681	---	44,473	---	26,534	---	27,500	---
East South Central	19,010	207,604	19,010	207,604	19,010	207,604	19,010	207,604
West South Central	39,206	9,381	14,609	9,381	14,609	9,381	10,867	9,381
Mountain	18,603	---	30,999	22,704	4,500	1,504	4,500	1,504
Pacific	626,387	69,680	327,811	13,000	59,793	6,225	58,593	7,425
	Percentage Distribution							
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
New England	0.1	1.3	0.1	1.5	0.2	1.6	----	1.6
Middle Atlantic	3.5	2.8	11.9	3.2	25.4	3.5	26.8	3.5
East North Central	11.6	2.7	8.9	3.1	10.9	3.4	8.3	3.4
West North Central	11.6	----	12.1	----	18.0	----	19.0	----
South Atlantic	4.0	----	6.8	----	10.3	----	10.5	----
East South Central	1.9	67.5	2.9	75.8	6.8	84.5	7.3	84.1
West South Central	3.9	3.1	2.2	3.4	5.3	3.6	4.1	3.6
Mountain	1.8	----	4.8	8.3	1.6	0.6	1.7	0.6
Pacific	61.6	22.6	50.3	4.7	21.5	2.6	22.3	3.0

*Data furnished by ninety-one organizations providing dental service in 1945.

Table 5.--Percentage of Members in Each Region Eligible for Specified Dental Care, 1945

Census Region	Percentage Distribution of Total Membership	Per Cent of Members in Each Region Eligible for Specified Dental Care			
		Diagnostic X-Rays	Extractions	Prophylaxis	Fillings
Total	100.0	27	19	11	10
New England	2.6	4	4	4	3
Middle Atlantic	13.8	6	13	12	12
East North Central	21.2	11	6	4	3
West North Central	7.6	31	21	13	13
South Atlantic	6.0	13	15	9	9
East South Central	5.6	82	82	82	82
West South Central	3.7	26	13	13	11
Mountain	2.9	13	37	4	4
Pacific	36.4	38	19	4	4
Hawaii	0.2	--	--	--	--

basis. In three other regions, the West North Central, West South Central and Pacific, roentgenograms were available to from 26 to 38 per cent of the members. Extractions were available to 21 per cent of the members in the West North Central Region and to 37 per cent in the Mountain Region. In all regions except the East South Central, less than 15 per cent of the members were eligible for prophylaxis and fillings (Table 5).

Types of Organizations Furnishing Dental Services.—Prepayment organizations of different types vary greatly in the scope of dental services provided (Table 6). Governmental plans were small in terms of total membership, but those established by the War Food Administration for seasonal farm workers made each of the four types of service available to their entire membership. Few members of other governmental plans were entitled to receive any of the four types of dental care. Prophylaxis and extractions could be obtained through prepayment arrangements by all persons belonging to consumer-sponsored plans financed partly by the Department of Agriculture, and 80 per cent of the membership were also eligible for fillings and 39 per cent for roentgenograms. Of all plans, those sponsored by the Department of Agriculture and the War Food Administration provided the most comprehensive dental care.

No medical society plans in states other than Washington and Oregon provided dental services. Some of the members of medical society plans in Washington and Oregon could obtain roentgenograms and extractions on a prepayment basis.

Almost three-fourths of the members of industrial plans financed jointly by employer and employe were eligible for roentgenograms either on a prepayment or a reduced-fee basis. More than one-half were entitled to extractions, and one-third could receive prophylaxis and fillings on a prepayment or a reduced-fee basis. Next to the organizations sponsored by the Department of Agriculture or the War Food Administration, which provided certain types of dental care to their entire membership, the jointly financed industrial plans had the largest proportion of members eligible for one or more of the four types of dental service.

Private group clinics provided one or more of the four types of dental service on a reduced-fee basis for from 20 to 29 per cent of their membership. Prepaid dental services in these organizations were limited almost entirely to roentgenograms and extractions, for which 26 and 19 per cent of the membership, respectively, were eligible.

About 33 per cent of the total membership of industrial plans financed entirely by employes were eligible for roentgeno-

Table 6.—Total Number Eligible for Medical Care in Prepayment Medical Care Organizations and Number and Percentage Eligible for Specified Type of Dental Service, Under Prepayment Contract or on Reduced-Fee Basis, by Type of Organization[a]

Type of Organization	Total Number Eligible for Medical Care	Diagnostic X-Ray		Extractions		Prophylaxis		Fillings	
		Prepayment	Reduced Fee	Prepayment	Reduced Fee	Prepayment	Reduced Fee	Prepayment	Reduced Fee
				Number					
Total	4,975,850	1,016,928	307,717	652,328	273,741	277,859	245,766	252,808	246,966
Industrial:									
Financed by employer	212,590	16,500	6,136	59,500	6,136	59,500	6,136	50,000	6,136
Financed jointly by employer and employe	546,772	247,200	141,182	149,615	163,886	40,650	142,686	40,650	142,686
Financed by employe	704,786	247,884	27,100	101,418	1,200	48,186	1,200	47,581	1,200
Medical society:									
Washington and Oregon	954,100	278,100	---	119,100	---	---	---	---	---
Other States	1,640,236	---	---	---	---	---	---	---	---
Private group clinic	406,330	104,663	117,693	78,183	93,138	1,200	80,138	---	81,398
Consumer sponsored:									
Financed partly by Department of Agriculture	23,553	9,160	---	25,553	---	25,553	---	18,777	---
Other	328,561	15,900	15,606	25,659	9,381	8,500	15,606	8,500	15,606
Governmental:									
War Food Administration and cooperating agencies	97,930	97,300	---	97,300	---	97,300	---	97,300	---
Other	15,602	191	---	---	---	---	---	---	---
				Percentage of Total Number of Eligible Persons					
Total	---	20.4	6.2	13.1	5.5	5.6	4.9	5.3	5.0
Industrial:									
Financed by employer	---	7.8	2.9	27.5	2.9	27.5	2.9	23.5	2.9
Financed jointly by employer and employe	---	45.2	25.8	27.2	30.0	7.4	26.1	7.4	26.1
Financed by employe	---	32.9	3.6	13.5	0.2	0.4	0.2	6.3	0.2
Medical society:									
Washington and Oregon	---	29.1	---	12.5	---	---	---	---	---
Other States	---	---	---	---	---	---	---	---	---
Private group clinic	---	25.8	29.0	19.2	22.9	0.3	19.7	---	20.0
Consumer sponsored:									
Financed partly by Department of Agriculture	---	38.9	---	100.0	---	100.0	---	79.7	---
Other	---	4.9	4.8	7.9	2.9	2.6	4.8	2.6	4.8
Governmental:									
War Food Administration and cooperating agencies	---	100.0	---	100.0	---	100.0	---	100.0	---
Other	---	1.2	---	---	---	---	---	---	---

[a]Data furnished by 229 organizations in 1945.

grams, and 14 per cent were eligible for extractions, each on a prepayment basis. No substantial proportion of the membership was entitled to receive other dental care on either a prepayment or a reduced-fee basis.

Of special significance is a comparison of the number of persons eligible for specific dental services with the total number eligible for some type of dental care. The accompanying chart shows the proportion of the membership eligible for the specific service on a prepayment and on a reduced-fee basis.

Dental Service in Relation to Comprehensiveness of Medical Care.—Most prepayment plans that provided some form of dental service also provided relatively complete medical care. All but 13,500 of the 1.5 million persons eligible for some type of dental service could receive physicians' services in the office, home or hospital for both medical and surgical cases. Of the 13,500 who were eligible for less extensive medical care, approximately 6,100 could receive physicians' services for hospitalized surgical cases, 5,800 were eligible for service for medical and surgical cases in the office and home and 1,500 for care of medical but not surgical cases in the office, home and hospital.

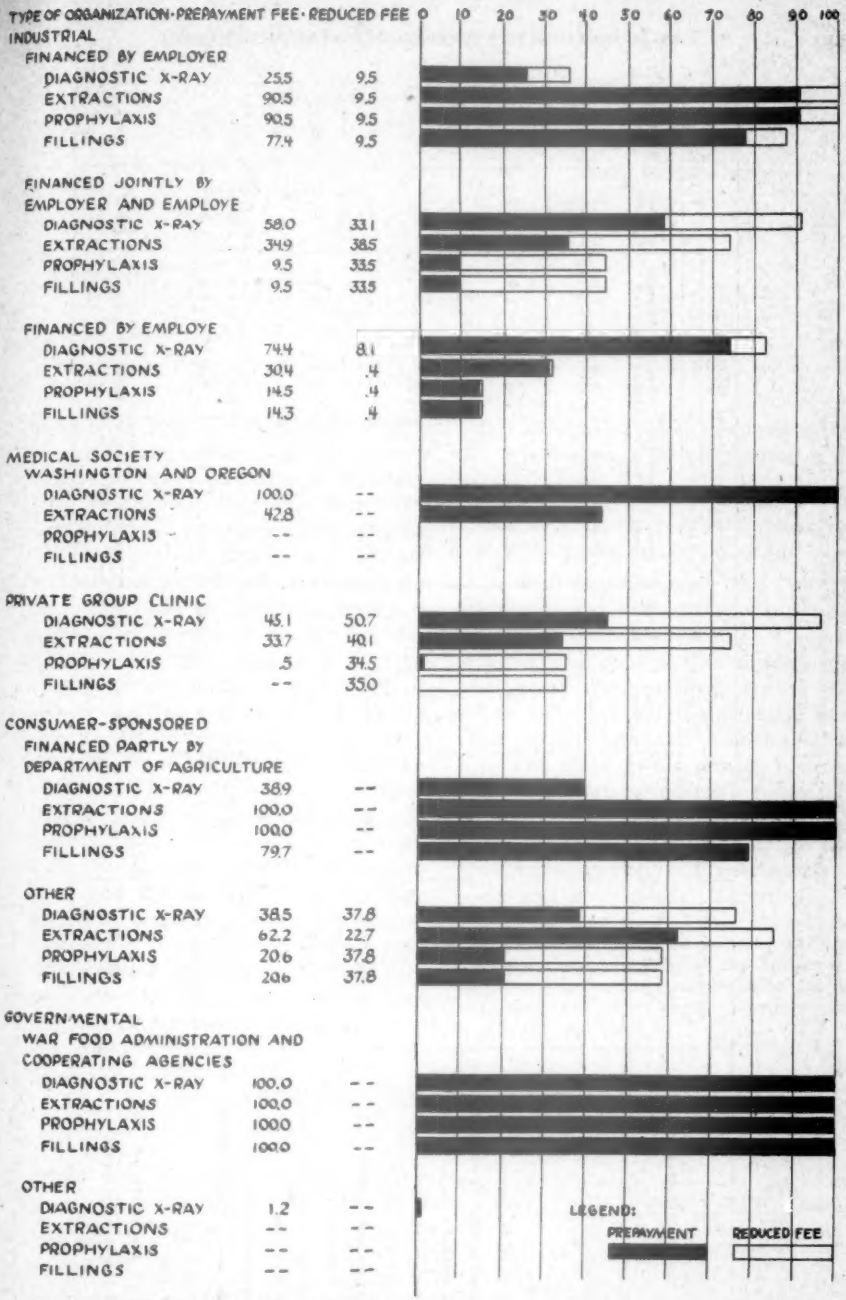
About half the persons eligible for relatively complete medical care could also receive one or more of the four types of dental care (roentgenograms, extractions, prophylaxis or fillings); 34 per cent were entitled to roentgenograms under the prepayment contract; 22 per cent were eligible for extractions, and 9 per cent for prophylaxis and fillings. In addition, one or more of the four types of dental service were available on a reduced-fee basis to from 8 to 10 per cent of those eligible for relatively complete medical care.

Table 7 indicates the variation among the different types of plans in making dental services available to persons entitled to receive relatively complete medical care. Next to the governmental plans of the War Food Administration (which provided all four types of dental care for all members) and consumer-sponsored plans financed partly by the Department of Agriculture (which provided prophylaxis and extractions for all members), the industrial plans financed jointly by the employer and employe most frequently combined some dental service with a relatively complete medical care program. About 83 per cent of the members of these plans could receive some type of dental service either on a prepayment or a reduced-fee basis. Almost three-fourths of the members of private group clinics who were entitled to relatively complete medical care could also receive one or more of the four types of dental care. Dental service was available for more than one-half of the comparable group in industrial plans financed by employes, for more than one-third in industrial plans financed by employers and for smaller proportions in plans of other types.

Dental Staff of Prepayment Medical Care Organizations

In 1945, more than 150 dentists were associated on a full-time or part-time basis with the twenty-five prepayment medical care organizations which furnished information on the number of dentists employed. Half of these salaried dentists devoted their full time to providing dental services to the 458,000 members of the organizations which employed them, while the other half spent part of their time in private practice. The other sixty-six organizations that furnished dental care were served by an unknown number of local dentists in private practice.

Industrial plans employed 126 of the 150 dentists in the twenty-five plans for which data are available. The consumer-sponsored plans which employed seven



Percentage of persons eligible for specified type of dental care, based on persons eligible for any type of dental care, by type of organization, 1945. Data furnished by ninety-two organizations in 1945.

Table 7.--Persons in Prepayment Medical Care Organizations Eligible for Physicians' Services in Office, Home and Hospital, and Percentage Eligible for Specified Type of Dental Service, by Type of Organization, 1945*

Type of Organization	Persons Eligible for Physicians Services in Office, Home and Hospital	Percentage of Persons Eligible for--								
		Any of the Four Types of Dental Service	Diagnostic X-Ray		Extractions		Prophylaxis		Fillings	
			Pre-payment	Reduced Fee	Pre-payment	Reduced Fee	Pre-payment	Reduced Fee	Pre-payment	Reduced Fee
Total	2,984,990	49.7	33.7	9.9	21.8	8.8	9.0	7.8	8.7	7.9
Industrial:										
Financed by employer	176,913	34.3	4.8	1.2	33.1	1.2	28.5	1.2	28.3	1.2
Financed jointly by employer and employe	502,856	83.1	48.8	27.1	28.9	31.6	7.7	27.4	7.7	27.4
Financed by employe	634,028	52.6	39.1	4.3	16.2	0.2	7.6	0.2	7.5	0.2
Medical society:										
Washington and Oregon	854,100	29.1	29.1	---	12.5	---	---	---	---	---
Other states	101,646	---	---	---	---	---	---	---	---	---
Private group clinic	309,092	74.6	33.9	37.6	25.3	29.6	0.4	25.4	---	25.8
Consumer sponsored:										
Financed partly by Department of Agriculture	23,553	100.0	38.9	---	100.0	---	100.0	---	79.7	---
Other	169,900	24.3	9.4	9.2	15.1	5.5	5.0	9.2	5.0	9.2
Governmental:										
War Food Administration and cooperating agencies	97,300	100.0	100.0	---	100.0	---	100.0	---	100.0	---
Other	15,602	1.2	1.2	---	---	---	---	---	---	---

*Data furnished by 168 organizations in 1945.

Table 8.--Number of Dentists Employed by Various Types of Organizations, 1943 and 1945

Type of Organization	Number of Dentists Employed			
	1943		1945	
	Full-time	Part-time	Full-time	Part-time
Total	83	87	77	77
Industrial:				
Financed by employer	8	4	11	3
Financed jointly by employer and employe	65	5	53	6
Financed by employe	--	60	2	51
Private group clinic	3	14	6	10
Consumer sponsored	2	4	3	4
Governmental	5	--	2	3

dentists in 1945 were financed entirely by their membership, while the governmental plans which employed five dentists were financed by the War Food Administration and cooperating agencies.

During the war, prepayment plans experienced great difficulty in maintaining adequate staffs of dentists, physicians, nurses and laboratory technicians. The number of dentists employed in these twenty-five organizations declined from 170 in 1943 to 154 in 1945, while the number employed on a full-time basis dropped from eighty-three to seventy-seven and on a part-time basis from eighty-seven to seventy-seven. Industrial plans financed by employers increased their dental staffs from twelve to fourteen, and the number of dentists employed by consumer-sponsored plans rose from six to seven. Governmental plans, while retaining the same number of dentists, reported three on a part-time basis and only two on a full-time basis; in 1943, all were on full-time appointments. All other types of plans reported a decrease. (Table 8.)

Dental Care Provided by Selected Prepayment Organizations

A few organizations* that provide relatively complete dental care and maintain records of the volume of service rendered and costs of care supplied supplementary data on their dental programs. The information available from these prepayment plans is not comparable. The plans do not provide identical services; they have different record systems and accounting procedures; they serve populations of different age and sex composition and different economic levels and occupations. Nevertheless, a

*Information on the Westchester Lighting Company Employees' Mutual Aid Society was not available in time for inclusion in the 1945 study conducted by the Bureau of Research and Statistics.

Table 9.--Number of Dental Services Received Per 1,000 Eligible Persons, 1941-1944

	1941		1942		1943		1944	
	White	Negro	White	Negro	White	Negro	White	Negro
Bridgework	36.9	38.2	43.2	17.2	23.6	1.8	6.7	2.7
Cleaning	103.1	22.8	217.2	81.6	194.5	48.0	132.3	25.3
Crowns	7.7	20.9	10.4	4.0	4.0	0.4	2.3	0.3
Dentures	83.7	25.5	114.0	30.8	65.8	1.8	52.0	5.7
Examinations	51.4	33.8	90.0	26.8	19.3	9.1	9.3	4.0
Extractions	178.2	164.6	245.2	148.0	217.8	83.3	206.3	83.0
Fillings	342.5	52.0	569.6	144.0	625.8	196.4	592.3	118.0
Gum treatments	192.0	95.4	217.2	106.8	205.1	85.1	154.0	46.0
Miscellaneous	149.2	67.1	250.0	125.6	208.7	140.4	151.7	74.0

*Data furnished by 168 organizations in 1945.

summary of the data furnished may be of interest to the members of the dental profession, especially those who are developing the experimental voluntary prepayment plan in dentistry outlined by the Council on Dental Health of the American Dental Association.

*American Cast Iron Pipe Company.**—This industry has a medical care plan financed by the employer. About 2,000 employes and their dependents, or a total of 8,000 persons, were eligible in 1944 for relatively complete medical care, including physicians' care in the clinic, home and hospital, hospitalization and comprehensive dental care. The employes are about equally divided between white and Negro, but the Negroes have a larger proportion of the dependents.

Dental service is provided by two part-time dentists and a full-time dental hygienist. During each of the past four years, the dentists have been on duty a total of about 2,350 hours—the equivalent of approximately one dentist working full time and one working about half time.

In a few instances, dental care is ordered by a physician, but generally the service provided results from the direct request of the workers or their dependents. There is a marked difference in the amount of service provided to whites and Negroes. Data on the dental services provided are available for the years 1941-1944. There were substantial increases in most of the dental services provided in 1942 as compared with 1941. With the exception of fillings, the number of services declined from 1942 to 1943; in 1944 the number of services of most types decreased further, as shown in Table 9.

All dental services are provided without cost, with two exceptions: any gold that is used and the materials used in making dentures must be paid for by the patient. During the four-year period for which data are available, the charges made to patients for such items have been very small. In each year, the number of persons receiving the services subject to such charges was about evenly divided between the employes and their dependents. In 1941 and 1942, the average expenditures for these materials were the same for employes and dependents, while in 1943 and 1944 the average for dependents receiving the service was higher than for employes (Table 10).

Consolidated Edison Employees' Mutual Aid Society, Inc.†—Dental care in this organization is offered as part of the medical services available to employes of an industrial company. Medical care as now provided is rather comprehensive and is an outgrowth of the company's forty years of efforts on behalf of its employes. The plan is supported by equal contributions from employer and employe and, although voluntary, has 99 per cent subscriber membership among eligible workers. In 1943, 21,800 persons were eligible for care, 18,700 men and 3,100 women; in 1944, 20,700 were eligible, 17,850 men and 2,850 women.

The plan includes the following dental services: prophylaxis; roentgenograms; dentures and denture repair; silver, porcelain, cement, alloy and amalgam fillings, and extractions, except for impacted molars and those requiring surgery. Complete dentures are supplied to members after at least two years' membership in the society. Dentures are constructed of vulcanized rubber and "True-Bite" teeth. Lower partial dentures are supplied if four or more lower molars are missing. Eight-year molars are not considered as missing molars. All partial dentures are constructed of vulcanized rubber, but include the necessary clasps. Dentures that have become unserviceable owing to normal condi-

*Birmingham, Ala.

†Brooklyn Edison Employees' Mutual Aid Society, Association of Employees of the New York and Queens Light and Power Company, 4 Irving Place, New York, N. Y.

Table 10.--Charges Made for Materials (Gold and Materials Used in Dentures), 1941-1944

Year	Number Having Charges		Total Charges to:		Average Charge Per Person Having Such Charges	
	Employes	Dependents	Employes	Dependents	Employes	Dependents
1941...	83	88	$1,407.00	$1,484.00	$17.00	$17.00
1942...	91	96	1,681.00	1,691.00	18.00	18.00
1943...	125	102	2,666.00	2,670.00	21.00	26.00
1944...	85	68	1,737.00	1,766.00	20.00	26.00

tions will be replaced. (Lost dentures are not replaced.) The substitution of any material other than vulcanized rubber for full or partial dentures is not permitted.

Dental care is provided by dentists who are employed on an hourly basis and work in their own offices—forty-five dentists in 1943 and thirty-eight in 1944. Both their work and their offices are inspected periodically by the association's dental consultant and one of the assistant medical directors. In addition to a $5 hourly rate,* the dentists receive payments for roentgenograms—$0.75 for single roentgenograms, $1.50 for half-mouth, $3 for full-mouth. They are reimbursed for the actual cost of certain types of dentures. The maximum payment for full dentures made of vulcanite rubber is $12.50 each. The cost of partial dentures varies but usually does not exceed $22 each. In 1944, a total of 15,350 hours were spent by dentists in carrying out the program—a decrease of 2,250 hours from the preceding year.

The dentists who participated in the program reported the time spent in providing care to employes of the company but not the number of each type of service given. The only information available on the number of services provided to each 1,000 persons eligible for care in each of the two years is presented in Table 11.

*Effective January 1, 1945, because of increased cost of materials, etc., dentists may temporarily make a 20 per cent surcharge for services, bringing their hourly rate up to $6.

This organization was the only one which could supply rather detailed information on the expenses incurred in providing dental service, because the hourly payment to dentists covers such items as depreciation of equipment, space, light, heat and the like. The only item of expense that is not included is an amount allocated to costs of collecting dues.

The annual cost of dental service provided by this organization per person eligible for care was $5.35 in 1943 and $4.89 in 1944. The items of expense are given in Table 12.

Macy Mutual Aid Association.† — Dental care in this organization was available in 1943 to approximately 10,000 employes and to 7,450 in 1944; it is included in the benefits provided by the association, which is financed by employer and employes. Dental consultations and emergency treatments are given without charge. All types of permanent dental work are done on a reduced-fee basis. In 1943, the dental

†R. H. Macy and Company, Inc., Herald Square, New York, N. Y.

Table 11.--Consolidated Edison Employees' Mutual Aid Society, Inc.--Number of Services Provided to Each 1,000 Persons Eligible for Care, 1943 and 1944

	1943	1944
Dentures.....	51.0	46.1
Denture repairs and relines.....	18.6	9.8
X-rays.....	332.9	335.7
Other services.....	1,697.1	1,471.8

Table 12.--Consolidated Edison Employees' Mutual Aid Society, Inc.--Expenditures for Dental Care, 1943 and 1944

	1943	1944
Administrative supervision (estimated)	$2,500.00	$2,500.00
Clerical works (estimated)	4,200.00	4,200.00
Laboratory costs	12,917.00	12,679.00
Payment to dentists	87,269.00	72,607.00
X-rays	9,682.00	9,233.00
	$116,568.00	$101,219.00

clinic gave a total of 6,963 services, while in 1944 the volume of services increased by 340.

The association, which was organized more than fifty years ago to provide sickness and death benefits to the company's employes, now includes a limited medical program and hospitalization. All benefits and expenses are paid from a fund to which each employe contributes 1 per cent of his weekly salary but not more than sixty cents a week, and to which the company contributes an amount equal to all dues collected monthly.

Dental care is given at the association's dental clinic, which, in 1944, was staffed by four part-time dentists, one full-time hygienist and two office assistants. During that year, 2,300 hours were spent on the program by dentists and 6,240 by two hygienists.

In addition to giving consultations and emergency care without charge, the clinic emphasizes the importance of regular cleaning of teeth by a hygienist. This service is done at a nominal charge ($1 to $1.50). A record is kept of each case, and the employe is recalled at six-month intervals for another prophylactic treatment.

Charges for permanent dental work are based on a fee schedule and vary in accordance with the employe's earnings. Patients are divided into four wage classes: those earning less than $20 a week pay 60 per cent of the basic charge; if the weekly wage is $20 to $30, they pay 75 per cent; $30 to $50, 87.4 per cent; those earning $50 or more a week pay the full basic rate. The basic charges during 1943, according to type of work, are shown in Table 13.

During 1943, 3,598 patients received emergency treatments, while 1,568 had permanent work done. In 1944, there was a decided increase in the number of patients receiving these services; 4,771 emergency visits were made to the clinic and 2,204 patients had permanent work done. The volume of dental service of each type increased. Table 14 shows the number of services provided in 1943 and 1944 to each 1,000 persons eligible for care.

Information is not available on the

Table 13.--Macy Mutual Aid Association--Basic Charges, According to Type of Work

Subject to reduction according to weekly wage:	
Simple silver fillings	$3.00
Compound silver fillings	3.50
Compound silver fillings with cement	4.00
Porcelain fillings	Same as silver
Prophylaxis	1.50
Gum treatments	1.00
Not subject to reduction according to weekly wage:	
Gold inlays	8.00 – 14.00, depending on laboratory charge
Repairs	Depends on laboratory charge
Extractions	1.50 for first tooth, 50 cents for each additional tooth
Root canal treatment, complete	8.00

Table 14.--Macy Mutual Aid Association--Number of Services Provided to Each 1,000 Persons Eligible for Care, 1943 and 1944

	1943	1944
Cleaning	173.7	200.0
Extractions	43.3	69.1
Fillings:		
Cement	12.5	13.0
Porcelain	81.5	102.7
Silver	236.5	297.0
Gold inlays	8.8	12.5
Repairs, type unknown	6.7	14.2
Treatments:		
Gum	26.3	34.5
Postoperative	33.3	49.8
Root canal	32.4	51.8
Miscellaneous	41.3	135.4

total cost of providing the service. In 1943, the salaries of the four part-time dentists, two full-time hygienists and one full-time secretary amounted to $12,280. In 1944, in addition to the four part-time dentists, the dental staff consisted of one dental hygienist and two office assistants, whose combined salaries amounted to $11,023. Supplies cost $1,520 in 1943 and $1,572 in 1944. Depreciation of equipment was reported as approximately $275 in both years. In 1944, 1,929 dental roentgenograms resulted in an income of $505, as compared with a net income of $313.50 from roentgenograms in 1943.

*Medical Care Plan, Jack and Heintz, Inc.**—This organization has a relatively complete medical care plan, including dentistry, the entire cost of which is paid by the company. The company employs four dentists, four dental assistants and one receptionist on a full-time basis for the dental department. Approximately 8,700 employes were eligible for care in 1944.

Information is not available on the number of persons who received some type of dental service during the year. A total of 27,000 services were provided, the most frequent being diagnosis and consultations, examinations, full-mouth roentgenograms, extractions and prophylaxis. Table 15 shows the number of services provided to each 1,000 persons eligible for care.

The total cost of providing dental service is not available. In the figures submitted, no allocation was made for the dental department's share of such items as cost of general administration, space, initial cost of equipment and depreciation. An expenditure of $51,000 was made for dental care in 1944, but it represents only certain items, as shown in Table 16.

Stix, Baer and Fuller Employees' Mutual Aid Association.†—This is an industrial plan financed jointly by employer and employes. It provides medical care in the clinic, home and hospital, but limits the annual amount provided for any one employe to $150, including cash disability benefits. In dentistry, one part-time dentist provides prophylaxis, fillings, extractions, treatments and emergency care.

All but 400 of the 2,500 employes eligible for care received some type of dental service. A slightly higher percentage of male than of female employes received dental care of some type. Persons in the age group of 45 to 64 years used the dental service most extensively, as is shown in Table 17.

Except for emergency care, prophylaxis was the service given most frequently. Age did not influence the receipt of prophylaxis among women; about 25 per cent in each age group received this service. Among men, there was a striking difference in the receipt

*Solon Road, Bedford, Ohio.

†Sixth and Washington Ave., St. Louis, Mo.

Table 15.--Medical Care Plan, Jack & Heintz, Inc.--
Number of Services Provided to Each 1,000 Persons
Eligible for Care, 1944

Dentures, repairs and relines	2.8
Diagnosis and consultation	660.9
Diagnosis, microscopic	6.2
Examinations	618.5
Extractions	382.5
Fillings:	
Alloy, one surface	6.9
Alloy, two or three surfaces	6.7
Synthetic or cement	11.7
Temporary	40.2
Re-cementing inlays and crowns and adjusting dentures	68.4
Treatments:	
Gum	85.4
Postoperative	174.4
Prophylaxis	237.1
Vincent's infection	78.9
X-rays:	
Full mouth	473.2
Bitewings	37.9
Single	135.2
Miscellaneous	35.3

Table 16.--Medical Care Plan, Jack & Heintz, Inc.--
Expenditures for Dental Care, 1944

Salaries of 4 dentists, 4 dental assistants, and 1 receptionist	$43,894.00
Dental supplies	5,748.00
Taxes and insurance	1,329.00
Repair to equipment	36.00
	$51,007.00

Table 17.--Stix, Baer and Fuller Employees' Mutual
Aid Association--Percentage of Employes in
Various Age Groups Receiving Dental Care

	Per Cent of employes receiving dental care	
	Men	Women
All	86	83
Under 20	45	84
20 - 24	71	84
25 - 34	86	81
35 - 44	91	74
45 - 64	94	98

of prophylaxis in the various age groups. None in the youngest age group had this service, but in the age groups 20 to 24 and 25 to 34, 62 per cent received this service during the year; the percentage was about 30 in the age group 35 to 44, while only 18 per cent of the men above 45 years of age had the service.

Twice as many men as women had extractions, about 13 per cent of the men as compared with 7 per cent of the women. The percentage having extractions was the same in each age group for both men and women, with the one exception that none of the men under 20 had extractions.

About 20 per cent of the men and women had fillings during the year. For women, age made little difference in the receipt of this service, but almost twice as many men in the age group 20 to 34 received the service as in the older ages. As with extractions, no fillings were reported for men under 20.

Treatments and emergency dental care were received by approximately one-third of the eligible membership. This was practically the only care received by the men under 20.

The organization reports that it is difficult to give an accurate figure on the cost of providing dental care, inas-

much as the administrative and clerical cost, maintenance costs and the cost of equipment cannot be separated from hospital costs. The costs of dental supplies and the dentist's salary, with a minimum allowance for the time of the receptionists and a clerk typist, amounted to $3,000, an average cost of about $1.50 per year for eligible person.

*Westchester Lighting Company Employees' Mutual Aid Society.**—In addition to a rather complete medical care plan, this organization offers its members comprehensive dental care. In June 1945, the 1,933 eligible employes (1,567 men and 366 women) were entitled to the following dental services: prophylaxis, treatments, extractions, fillings, roentgenograms, inlays, crowns, partial and full dentures and repairs to dentures. The plan is jointly financed by the employes and the employer through a mutual aid society and is administered by a board of managers, elected annually by the employes.

The staff of fourteen dentists is paid by the society for the amount of work performed for employes in accordance with an established allowance schedule. On completion of the work, the dentist fills out a form supplied by the society on which he indicates the amount and the type of service rendered and sends it to the society for payment. The amount allowed generally is sufficient to cover the cost of ordinary procedures, as is illustrated by the schedule of allowances given in Table 18.

One of the unusual features of this plan is the use of the family dentist. A member, if he prefers, may be treated by his family dentist, rather than by one of the staff dentists. The same allowances are made for work done by the family dentist as for work done by the staff dentists. If the charges of the family dentist exceed the allowance, the member pays the dentist the difference.

Available data show that 1,375 members were treated in 1943 at a cost of $15,255.25—an average of $11.09 per member treated, while, in 1944, 1,219 persons received care at an average cost of $10.50 per member treated. The average cost of care per member eligible was $7.50 in 1943 and $6.63 in 1944. The dental hygienist in the dental clinic operated by the company gave 771 prophylactic treatments in 1944. This service, which was begun about five years ago, has proved popular with the em-

*9 South First Ave., Mount Vernon, N. Y.

Table 18.—Westchester Lighting Company Employees Mutual Aid Society—Schedule of Allowances for Dental Procedures

Extractions: first tooth $3.00; others	$2.00
Fillings, silicate and amalgam:	
Simple, one surface	2.00
Compound, more than one surface	3.00
Impactions, maximum allowance	15.00
Prophylaxis	2.00
Treatments*	1.00
X-rays:	
Single	.75
Half series	3.00
Full series	5.00
Dentures,† maximum allowance (balance paid by employe)	10.00
Gold inlays or crown, maximum allowance (balance paid by employe)	3.00

*Includes toothache, abscessed teeth, trench mouth, pyorrhea and gum treatments; excludes any root-canal treatments.

†For repairs to dentures, an allowance is made at the rate of $6 per hour but may not exceed $10; the member pays for laboratory work and material.

ployes, as is shown by the fact that 230 more prophylactic treatments were given in 1944 than in 1943, although the total number of members treated by dentists declined by fifty-six in the same period. The work of the dental hygienist, under the supervision of a dentist, consists of prophylactic treatments, examining teeth and recording the findings on a dental form which the employe gives the dentist and maintaining a record of all service rendered to each employe. No statistics are available on the volume of services given by dentists.

*Consumer Sponsored Organizations Financed Partly by the Department of Agriculture.**—In 1942, the Interbureau Coordinating Committee on Post-War Programs, U. S. Department of Agriculture, developed rural health programs for six associations. Five of these plans are still in operation: in Nevada County, Ark.; Walton County, Ga.; Newton County, Miss.; Cass County, Texas, and Wheeler County, Texas.† Residents of the county who obtain most of their livelihood from agricultural pursuits are eligible for membership. Subscribers and their families receive relatively complete medical care. In Nevada County, Ark., the subscriber pays an amount equal to 7 per cent of his net cash income for 1942, but not less than $13 or more than $48; when the payment is less than $48, the Department of Agriculture pays the difference. Although they vary somewhat, financial arrangements similar to those in Nevada County are used by the other four associations. During the first year of operation, approximately 36,000 persons were eligible for dental care through the six associations then in operation, and the amounts paid to dentists for their services totaled $53,000. At the end of this period, one project ceased operation, another discontinued dental services and all associations increased membership fees. As a result, the number of persons eligible for dental care during the second year of operation was reduced to 23,000 and the amounts paid to dentists to $33,000. The four associations now giving dental care provide prophylaxis and extractions for all members. All associations place special emphasis on fillings for children, and three provide a limited amount of this service to adults. One provides roentgenograms.

Governmental Organizations — War Food Administration and Cooperating Agencies.‡—The Department of Agriculture also provides health services for seasonal farm workers, domestic and foreign, recruited, transported, housed or placed by the War Food Administration or a cooperating agency. These workers receive extensive medical care without charge, and the government pays the total cost of the program. The number eligible for services varies greatly with the seasons. Dental services, consisting of prophylaxis, extractions, fillings and roentgenograms, are provided in the associations' own clinics and by referral to local dentists. In 1942 and 1943, more than two-thirds of the ap-

*For addresses of individual organizations, see Bureau Memorandum No. 55, cited in Margaret C. Klem: Prepayment Medical Care Organizations. Ed. 3. Washington: U. S. Government Printing Office, 1945.

†These associations are quite separate from the Farm Security Administration's health associations, through which Farm Security Administration borrowers finance their medical care on a prepayment basis. Through these Farm Security Administration plans, 240,000 persons were eligible for dental care and $140,000 was expended for dental services in the fiscal year 1942-1943. During the fiscal year 1943-1944, although Farm Security activities had decreased, 175,000 persons were eligible for care and payments for dental care amounted to more than $100,000.

‡For addresses of individual organizations, see Bureau Memorandum No. 55, cited in Margaret C. Klem: Prepayment Medical Care Organizations. Ed. 3. Washington: U. S. Government Printing Office, 1945.

proximately 9,500 dental cases reported each year received services in the associations' clinics. Payments for dental care amounted to about $40,000 annually. For clinic services, the sum was almost the same in each year, $24,178 in 1942 and $24,888 in 1943; for referral services, the amount increased from $13,897 in 1942 to $17,167 in 1943. Payments per service in the clinic averaged $1.71 in 1942 and $1.24 in 1943; for referral services, the amount dropped considerably from $3.99 per case in 1942 to $1.95 in 1943.

AMALGAM—INCONSISTENCIES IN ITS USE IN RESTORATIONS*

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The success or failure of an amalgam operation depends entirely on the attention paid to details, considered of little consequence by most dentists. Therefore, the prerequisites to a successful amalgam restoration may be listed as (1) use of accepted alloys, (2) correct cavity preparation, (3) use of the rubber dam, (4) an unyielding matrix adaptation and (5) intelligent management of the amalgam. There can be no compromise if the best is to be realized from this material.

Since Black's "Operative Dentistry" is considered fundamental and his amalgam research brilliant even today, two paragraphs from his first edition, which conclude his chapter on amalgam, will be quoted:

> The idea that amalgam is a cheap filling to be done quickly in any old way should be discarded forever. The dentist should have the same pay for time in making amalgam fillings as in making gold fillings and take the time to do it well. If he does his duty as well, the service to his patient in proportion to the time employed will be just as valuable.
>
> Fillings properly made of modern amalgam are a close second to gold in their durability and in their protection against the recurrence of caries. The difference is that amalgam is more difficult to make perfectly. It is more difficult to learn the manipulation and even then it is more difficult to secure perfect results regularly, filling after filling.[1]

It is evident that the man whose research resulted in the balanced alloys which we use today regarded amalgam as a material to be handled in a definite and consistent manner. More recent investigators have repeatedly warned us of the delicacy of amalgam and have given us methods for its proper management,[2] but we repeatedly read that it is a much abused material.[3] Observations by Fee,[4] Easton[5] and others indicate that utter disregard of the basic principles of operative dentistry is common in the profession, especially when amalgam is used.

*Read before the Florida State Dental Society, November 10, 1944.

1. Black, G. V.: Operative Dentistry. Vol. 2, Ed. 1. Chicago: Medical Publishing Co., 1908.

2. Hollenback, G. M.: Economic Value of Amalgam in Operative Dentistry and Technic for Its Use. J.A.D.A. 24:1318, August 1937.

3. Romnes, A. F.: Clinical Aspects of Amalgam Restorations. J.A.D.A. 28:54, January 1941.

4. Fee, A. H.: Contacts and Contours. J.A.D.A. 27:1035, July 1940.

5. Easton, G. S.: Causes and Prevention of Amalgam Failures. J.A.D.A. 28:400, March 1941.

Probably such common abuse of a good filling material has prompted the research that takes into consideration the variables of amalgam in its relation to particle size of the alloy,[6] trituration,[7] condensation[8, 9] and moisture contamination.[10]

Dentists, as a rule, are neither chemists nor physicists. It is beyond our scope to consider the delicate intricacies of the chemistry of amalgam, but there are certain fundamentals of its management that can be learned by the average practitioner. The alloys accepted by the Research Commission of the American Dental Association are the best, in the light of our present knowledge, and will give good results if we put into use the basic principles of operative dentistry as outlined by Black.[1]

The Cavity

No filling material should be expected to give good service if reasonable care is not taken in preparing a cavity for its reception. Amalgam has little tensile strength, and the bulk necessary to overcome this fault calls for a deep and wide cavity. It has a tendency to expand, demanding more retention than most filling materials. Retention should not be obtained by sharp angles, but by grooves, adequately wide and deep.

The principle of extension for prevention is as important for amalgam as for any other filling, because there is less corrosion of the margins if they are extended into self-cleansing areas. It must always be remembered that the coefficient of expansion[11] of amalgam is far greater than that of tooth structure. Much care should be given to the elimination of weak walls and careful cutting of the cavosurface angle to make certain that the enamel is supported by sound dentin. A good rule to remember is: Make the angle of cavity wall to cavity floor slightly obtuse.[12]

The graceful outline of the cavity requires little time, but it is important, for it assures an esthetic restoration. A carelessly cut outline, rough and irregular, results in faulty adaptation of the amalgam to the cavosurface angle. Fracture of the irregular overhanging projections of enamel will follow. The smooth-cut spiral fissure bur is ideal to plane the enamel walls of the occlusal cavities. Sandpaper disks are practical for the proximobuccal and lingual margins. The end cutting bur is ideal for a level gingival floor margin.

The Gingival Third Cavity

The floor of the gingival third cavity should be as convex as the surface of the tooth. If it is not, the mesial and distal extremities will be too shallow to permit retention. We must bear in mind the principles of Black when we plan the Class V cavity. He suggests extending the gingival margin below the free gum line and states that the cavity outline should include the line angles of the tooth.[1] Sweeney[13] emphasizes the wheel bur to

6. Jarabak, J. R.: Effect of Particle Size on Dimensional Change in Dental Amalgams. J.A.D.A. 29:593, April 1942.

7. Hollenback, G. M.: Behavior of Amalgam and the Technic of Its Use. J.A.D.A. 24:386, March 1937.

8. Sweeney, J. T.: Uncontrolled Variables of Amalgam with Significant Improvements in Making of Restorations. J.A.D.A. 27:190, February 1940.

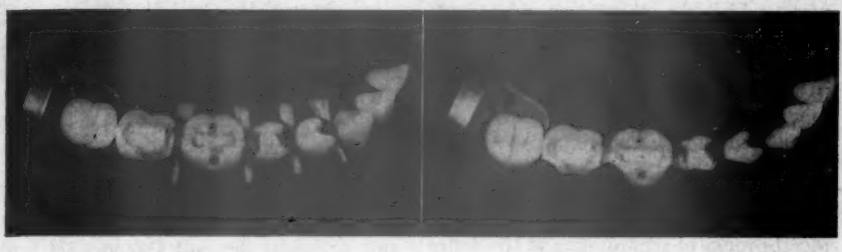
9. Ward, M. L., and Scott, E. O.: Further Studies of Effect of Variations in Manipulation on Dimensional Change and Flow of Amalgam. J.A.D.A. 22:1164, July 1935.

10. Research Commission: Excessive Expansion of Amalgam. J.A.D.A. 29:292, February 1942.

11. Cir. C433, National Bureau of Standards, p. 14.

12. Cannon, E. E.: Amalgam: Necessity for Consideration of Its Physical Properties and Practical Technic. J.A.D.A. 25:205, February 1938.

13. Sweeney, J. T.: Class 5 Amalgam Restoration. J.A.D.A. 29:2140, December 1, 1942.



a b

Fig. 1.—Practical method for multiple restoration. *a*, dark rubber dam, No. 18 molar clamp, bands and wedges adjusted for complex cavity of second molar, mesioclusodistal of second bicuspid and mesioclusal of first bicuspid. Including the occlusal buccal cavity of the first molar, four restorations can be made in one appointment. *b*, matrices reinforced with compound. Firm contacts are assured by placing a hot plastic instrument against the band on the cavity side and pressing firmly against it until the adjacent contact is made, the compound yielding where heat is applied. The removal of this matrix will not disturb the filling. The buccal compound is first removed. The band on the buccal surface is held firmly with the finger while the lingual compound and wedge are next dislodged. The band offers an excellent guide for initial carving of the marginal ridge. The band should be withdrawn in a lingual-buccal direction.

cut deep into the mesial and distal extremities for retention. This type of bur will leave the enamel rods well-supported by dentin. Therefore, retention as well as extension is important for the Class V or gingival third cavity.

Matrices

The foundation of the two-surface amalgam operation is the matrix or mold. Care and planning at this stage may convert failure into success. Various mechanical matrix holders and bands were described by Green, Shellman and Simon[14] in their brief history of matrices:

> Every cavity presents a problem for applying a matrix, and, in spite of the wide selection of mechanical retainers, there occasionally is seen a case in which the matrix cannot be used. . . . This brief history . . . has been introduced to show the ingenuity of the dental profession in its search for "a perfect universal" matrix retainer and holder.

Our clinical experience with many mechanical and universal retainers has been disappointing. Excellent results have been obtained with the matrix adaptations introduced to the profession by Hollenback[2] in 1937. This adaptation is easily and quickly accomplished, lending to the finished restoration the natural contour and contact so necessary for the protection of the interproximal gum tissue and the health of the adjacent teeth. The first attempts to construct the matrix may be discouraging, but, with a little practice and patience, the procedure can be mastered. Of course, the rubber dam must be used to maintain a dry field so that the modeling compound will adhere to the teeth.

The Hollenback matrix does not require a holder. It will perform as well with the mesioclusodistal cavity as it will for the two-surface cavity. Multiple prepared cavities may be fitted with this type of matrix in one section of the mouth and kept dry by the rubber dam because there are no mechanical devices to obstruct the field of operation. When in place, this matrix may be reshaped to secure ideal contacts and contours by placing a hot plastic instrument against the matrix band from the cavity side. Best of all, it will not yield under pres-

14. Green, R. D.; Shellman, J. P., and Simon, W. J.: Manipulation of Amalgam. J.A.D.A. 30:1168, August 1, 1943.

sure, which is the most important requisite of all matrices.[2] This matrix, like all good matrices, is supported by a contoured wooden wedge made from a tongue blade and tightly adapted to the gingival margin. The wood, when softened with water, automatically adjusts itself to the concavities frequently found on upper molars and bicuspids. The metal prongs of separators and the celluloid wedges that have been offered to the profession have been found generally inadequate, for the gingival margin must be absolutely tight to prevent the passing of amalgam into the gingival area.

Another problem is the lone tooth that demands a compound filling. The most practical matrix for this problem is the continuous copper band. The band should be well fitted and further reinforced with modeling compound to eliminate yielding. Since there are no adjacent teeth, the matter of contact and overhanging the gingiva is not a cause of concern. In very complex preparations wherein the restoration medium approaches a crown, the band can be so fitted that it may be left on for a few days.

The most exasperating problem is the Class II cavity wherein the gingival portion extends below the interproximal gum margin well into the root area. For this unusual type, the Hollenback matrix is very suitable. It may be necessary to sever the interproximal portion of the dam and insert a carefully prepared wedge deep in the interproximal tissue. Further augmented with compound, the matrix will be firm. Of course, there will be tissue injury. Usually, the tissue in contact with such a deep-seated cavity is diseased and the slight injury caused by the extended wedging heals quickly to a healthy condition after the cavity has been filled with a smooth amalgam presenting no overhang. Smooth, carefully packed amalgam invites health of the gum tissue.

Matrix for Class V Fillings

Matrix adaptations for Class V amalgam fillings have been proposed at various times, but all are difficult to adjust so that adequate condensation of the amalgam may be realized. In 1942, a set of three overpacking condensers were designed which, when attached to a handle, act as both a packing instrument and a condenser, and the use of these three matrix condensers for bicuspids and molars simplifies both matrix adaptation and condensation. Fillings of this class may now be made eminently successful in a few minutes with the least effort on the part of the dentist.

Uniformity

Contrary to the opinion of certain writers, amalgam fillings may be made successfully, filling for filling. There is no reason why one restoration should be better or worse than its neighbor. The road to consistently superior amalgams is an easy one, provided each operation is standardized, the details of the procedure are memorized and reasonable care is employed to avoid contamination. The requisites for a definite technic are (1) use of the rubber dam, (2) liberal extension and retention of the cavity, (3) rapid and complete trituration, (4) employment of a firm and adjustable matrix, (5) condensation using smooth faced condensers designed to fit the cavity to the fullest and (6) finishing and polishing a week or more later, with care not to cause heat during the polishing.

Rubber Dam

It is common opinion that the rubber dam is unnecessary. In our experience, a cavity cannot be kept dry without this protection. Available information cautions us that moisture will cause expansion of amalgam.[15] That the rubber dam

15. Schoonover, I. C., and Souder, Wilmer: Corrosion of Dental Alloys. J.A.D.A. 28: 1278, August 1941.

is not more generally used is a reflection on our profession since it is the greatest time-saver that we have and its use adds greatly to the comfort of the patient and the ease of operation. To those who wish to raise the standards of their practice, this method of operative procedure is recommended.

The importance of a dry cavity for amalgam operations is emphasized by the recent research of Phillips, Boyd, Healey and Crawford[16]:

> It is our feeling that the most valuable application of the discovery of delayed expansion is not so much the damage of excessive expansion due to contamination in mulling, but in the expansion resulting from contamination by saliva during the insertion of amalgam in a cavity.

The intelligent use of rubber-dam clamps is important. It is advisable to stone off the extensive wings of the bicuspid and molar clamps so that the dam will slip easily over them without tearing, and also there will be no interference with the application of the wedge in matrix adaptation.

The use of modern cervical clamps makes gingival cavity preparation a simple procedure. The Ferrier and ivory cervical No. 6 clamps are easily adjusted to anterior teeth and the ivory gingival clamp No. 9 is designed for gingival third cavities of bicuspids. Molar clamps will suffice for most cervical cavities of molars, but in those cases wherein there is extensive caries below the gingival tissue, it is often necessary to use a clamp having sharp extensions that will force the tissue away from the cavity and hold it there. From our clinical observation, the common use of the dam has not only simplified operative procedures, but has certainly been an aid in assuring constant results.

Amalgamation should be complete and the amalgam uncontaminated.[15] Since uncoated alloy particles or pieces of set amalgam or moisture will cause corrosion, the trituration device should be clean and dry and the squeeze-cloth should be used for only one filling and should then be washed and dried for further use. Because we are advised that amalgam over 5 minutes old is undesirable,[9] a method of trituration should be employed that is rapid and complete. It is necessary that fresh amalgam be used in extensive restorations which require more than one mix.

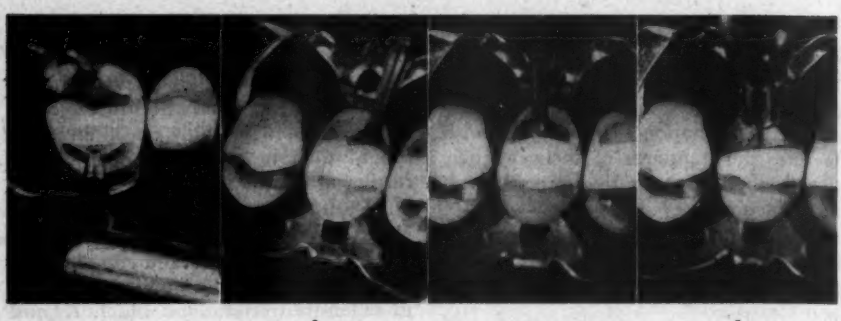
The use of the mechanical amalgamator which is regulated by a timer has been an aid in overcoming the inconsistencies of amalgamation. As a time-saver, it is invaluable, and its ease of manipulation makes this part of the amalgam technic a constant and easy procedure. After the few seconds required by this machine to make the amalgam, it is good practice to empty the contents of the capsule into a clean piece of rubber dam and to mull the amalgam a few seconds, to make sure of complete amalgamation. Rolled into a rope, the amalgam is allowed to remain on the dam, where it is cut into pieces. It is then ready for use. In this way, we have not allowed amalgam to touch our hands; nor is there a possibility of moisture contamination from the bracket table.

Condensing

The desired piece of amalgam is picked up with pliers and placed on the squeeze-cloth and it is twisted with enough force to remove the liberal excess of mercury. If hand condensers are to be used, it will be necessary to replasticize this apparently dry amalgam by rubbing it a few times in the cloth, to make it workable. If the mechanical condenser is used, the dry amalgam will gain a workable consistency as it is condensed in the cavity.

The Hollenback pneumatic condenser is valuable as regards time and consis-

16. Phillips, R. W., et al.: Clinical Observations on Amalgam with Known Physical Properties. J. D. Res. 22:157, June 1943.



a b c d

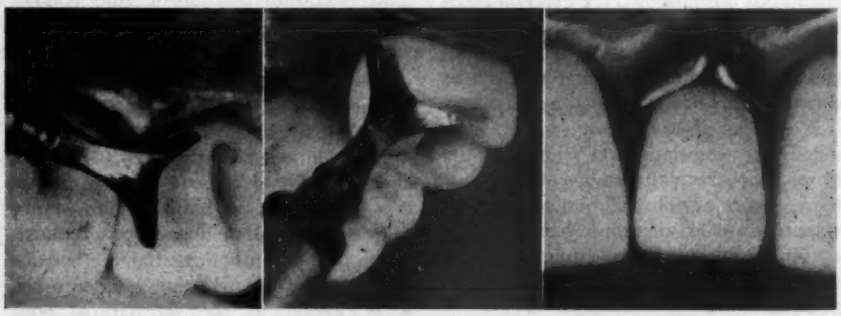
Fig. 2.—*a*, concave molar gingival condenser. *b*, concave condenser for very convex floor of bicuspids and cuspids. *c*, concave condenser in cavity. This instrument is used to condense the amalgam until the margins are overfilled. *d*, overpacking condenser for extensive gingival cavities of bicuspids and cuspids.

tency. The mallet force causes yielding of the matrices that are not reinforced with compound, even though it is regulated to the minimum pressure. Its rapid action brings the mercury to the surface, while the amalgam is condensed more rapidly than with hand instruments, thus permitting the removal of excess mercury in greater quantities than are possible with hand pressure and with greater ease. It is inadvisable to use this machine in overpacking the occlusal surface filling without marginal protection. The force of the mallet is so great even at minimum pressure that it can fracture the enamel rods. Adequate protection from the force of the blow in overpacking can be accomplished by use of a pledget of cotton or the rubber plunger from an anesthesia carpule in which the instrument is embedded.

Although I employ both hand and mechanical methods of condensing, it is my opinion that good results can be had with either technic.[8]

Instruments

The shape of the condenser face is



a b c

Fig. 3.—*a*, "saddle-point" condenser, designed for distolingual groove of upper molar. *b*, "saddle point" in correct position for overpacking. This instrument may be used for occlusal extension into the buccal groove of lower molars. *c*, instrument designed for overpacking in gingival restorations of incisors.

important. It should be as large as the cavity will permit[1] and should be shaped so that it will easily condense the amalgam at the line angles of the cavity.[8] The ledged condenser point offers a convenient method for removing excess mercury as the filling progresses. In the case of cavities of the gingival third variety, we have the problem of the convex floor. It is evident that flat-faced condensers are not so effective in packing amalgam in the undercut extremities as is a condenser that is as concave as the floor is convex.

The building of condenser points is the result of necessity and, as time goes on, we find need for one of a particular shape, such as the condenser face designed for condensing amalgam into the distolingual groove of the upper molar. Such devices tend to make our efforts more accurate and the results more gratifying.

Damaging Procedures

Sweeney has accomplished much in providing a uniform technic that will overcome the inconsistencies of amalgam manipulation. The adoption of automatic amalgamation has eliminated many of the variables of trituration. The practice of mulling amalgam in the bare hands, overtriturating it and incorporating in it dirt and perspiration, must be discontinued; and we should discontinue the practice of apportioning the alloy and mercury by guess. Black[1] suggests the correct measurement by weight.

Probably the greatest inconsistency in amalgam procedure lies in building the filling. Elsewhere in this paper, I have dwelt on the importance of a dry cavity and a dry field that will permit a rigid matrix. Schoonover and Souder,[10] in their study of corrosion, give this advice: "If corrosion and the formation of corrosion cells are to be prevented . . . condensation should be such that there will be no crevices and cracks and a homogeneous surface will be obtained." We

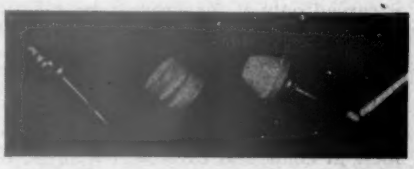


Fig. 4.—Occlusal overpacking instrument made from rubber plunger of anesthetic carpule.

have had good information regarding the proper methods of condensation of amalgam and the instruments to be used. We have been cautioned that the first portion should not be mercury-rich for the purposes of adaptation,[1] but every piece of amalgam should be relieved of the excess of mercury before it is condensed. Also, the importance of removal of the mercury-rich amalgam should be kept in mind during this operation. The filling should be homogeneous and, for this reason, the practice of overpacking with plier-expressed amalgam should be discouraged. Extra-dry amalgam used to take up the excess mercury does not join the already condensed amalgam, as we expect. Surfaces do not retain their polish and corrosion results.

Removal of the matrix and carving of the filling can cause much damage. The preliminary carving may be accomplished before the compound is removed. After removal of the compound, it is good practice to allow the matrix band to remain to serve as a guide for carving of the marginal ridge, which can be done with a curved explorer. The occlusal surface is carved with a Ward carver, with care to remove the excess over the margins. The ridges should be accentuated, but fissures must be shallow. Burnishers should not be used. The matrix band is removed by pulling buccally in the direction of its convexity, thus rounding the contact. Regaining lost contact by packing against the marginal ridge causes damage. If the management of the matrix is executed properly, a good contact is assured. The proximal surface

is carved only at the lingual and buccal margins.[17]

Polishing

Of all filling materials, amalgam possesses the most undesirable physical qualities, in color and surface roughness, if left unpolished. It is puzzling to see so many rough and grayish brown amalgam fillings when, with a little effort, they can be polished, once the correct procedure is learned. In my practice, an appointment is made for the purpose of polishing recent fillings, and x-ray examinations are made to be certain that there is no overhanging of amalgam. Stiff wheel and pointed brushes designed for this operation are necessary. Files and mounted stones and plug-finishing burs are essential implements. Their use is worth the time and effort.

Sweeney[13] warns against overheating amalgam and advises the use of wet paste and brushes for polishing. "At no time should the powder be allowed to become dry."

Since the dimensional changes of amalgam take place over a few days, it is best to allow a week before polishing is attempted. Polishing must be done in a manner that eliminates excessive heat. The brushes should be soaked in water and the abrasive powder should be of paste form, being combined with glycerin or water. If a glycerin paste is used, it is better to polish under a steady stream of water. This practice is not so practical as using a water-saturated paste, applied often enough to prevent overheating.

The procedure for polishing a two-surface amalgam filling is as follows:

1. Sandpaper disks are used to smooth the buccal and lingual proximal surfaces. Files are used to remove amalgam overhanging the gums.

2. Mounted stones are used to eliminate the roughness of the occlusal surfaces. This procedure is followed with barrel-type plug-finishing burs to remove the amalgam excess over the margins and to reshape the fissures so that they are not too angular or sharp at the bottom. The filling at this point is an anatomic restoration, but close examination with a magnifying glass reveals a network of scratches which, if not removed, will corrode.[15]

3. Wet paste of silex or pumice is liberally applied to the filling and a water-saturated stiff wheel brush is applied to the occlusal surface and the exposed proximal surfaces. The pointed brush is used to remove the scratches in the fissures. During this procedure, it is best to allow the brush to remain at a given place only momentarily, thus avoiding heat, at the same time applying liberal amounts of the cooling paste. A close examination of the filling will show whether the surfaces are acceptable for the final polish.

4. A wet paste of whiting and water is liberally applied to the filling and a brilliant polish is gained with the light application of a water-soaked Abbott's wheel brush.

Discoloration

Black[1] definitely asserted that use of amalgam was, because of its poor color, limited to bicuspid and molar cavities. He stated that there was no danger of discoloration of the tooth structure supporting amalgam, unless there was shrinkage and marginal adaptation was affected. Modern technic has given this material a wider range of use. There is reason to believe that tooth discoloration from the use of amalgam may have another source. I have had experience with discoloration of anterior teeth as well as the proximal supporting walls of posterior teeth that were filled with amalgam, in cavities that were not varnished.

This discoloration is not noticeable until months after restoration, and a

17. Sweeney, J. T.: Manipulation of Amalgam to Prevent Excessive Distortion and Corrosion. J.A.D.A. 31:375, March 1, 1944.

Fig. 5.—Finished amalgam restoration. Deep carving is contraindicated. Scratches must be removed and polishing accomplished with wet paste and brushes.

light gray in time progresses to a darker shade. This has not been understandable, because every means to eliminate moisture contamination was practiced. The use of the rubber dam and meticulous management of the amalgam and dehydration of the cavity were the usual procedure.[18] Applebaum, in his study of ground sections of tooth structure discolored by amalgam, found that mercuric sulfate was carried through the dentinal tubulae and was embedded in the matrix of the enamel. This probably accounts for the delayed and progressive discoloration. Schoonover and Souder[15] noted excessive corrosion of amalgam where it lay on the cavity floor and called attention to the possibility of moisture contamination from tooth structure. They found the elements of amalgam in the darkened areas.

The lesson gained from this experience is twofold: The structure of the tooth is a possible source of moisture and every means should be taken to close the dentinal canals by the use of varnishes or cements, and the risk of possible discoloration is good reason for not building large fillings in thin-walled anterior teeth.

To date, we have encountered no discoloration from gingival third amalgam restorations, either in anterior or in posterior teeth when retention was carried out in the dentin. Many of these cavities were not protected with varnish for experimental purposes, and, from the conclusions, we can safely build anterior gingival amalgam fillings provided the floor and the walls of the cavity are sealed with varnish and other means are employed to eliminate contamination from moisture.

A well-built and correctly polished anterior gingival third amalgam filling retains its platinum-like color when oral hygiene is satisfactory.

Economic Value of Restorative Dentistry

It is certainly necessary that the layman be educated to appreciate the value of the natural teeth. Those of us who use every means to restore the teeth to a healthy and functional condition should receive remuneration comparable to that from replacement dentistry; that is, bridge and denture work.

Frequently, poor fillings that are the source of much criticism are the result of insufficient remuneration for the time spent in operative procedures. In all probability, the ruthless extraction of teeth in some communities is the result of the public's lack of appreciation of restorative dentistry. Certainly, it is time that every effort be made to stop the too common practice of selling dental commodities instead of dental service. Those men who maintain a high standard of practice enjoy the enviable position of selling dental service and, through their efforts, have educated their patients to appreciate this service. It is the responsibility of such practitioners to make known to the profession the methods that they employ.

18. Applebaum, Edmund: Teeth as Vital Organs. J. D. Res. 9:487, August 1929.

The relative importance of inlays at the time that I received my dental instruction may account for the fact that amalgam was regarded as a second-rate material. For many years, the cast filling was regarded the most important tooth-saver, but the difference in cost of the two fillings made it necessary to use amalgam.

The importance of the young permanent teeth has been the cause of much concern. Invariably, these young molars and bicuspids were filled with amalgam because inlays were too costly. The realization that these teeth are more important, because they have so many years to serve, increased the desire to learn more about amalgam. With the practical technic of Sweeney,[8, 13, 17, 19, 20] the results are so gratifying that practically all posterior teeth are now filled with amalgam.

There is no economic reason why remuneration for amalgam restorations should be less than for other fillings. We have only one thing to sell and that is service. The measurement of the value of service is time. For that reason, there is no justification for short-cut methods, if they have undesirable results.

Responsibilities

Like all restorative work, the amalgam filling should possess the surface qualities to make it a fit substitute for lost tooth structure.[21] It should be smooth and anatomic, with regard to the supporting structures, a responsibility that we must shoulder because we must remember that the teeth are no stronger than the structures that support them.[22] The proper contour, marginal edge and adjacent contact are necessary for all restorations, constituting a service which does much to insure the health of the mouth. We must exercise full responsibility in prevention because it is the best "cure."[23] A knowledge of operative methods of protective dentistry is our unqualified responsibility. There is no justification for the assumption that amalgam is "third rate," in the category of cheap temporary fillings. If this were the case, it would be better to discard it and use something else. It has one advantage over other fillings: It takes less time to build, and thus more teeth can be filled in a given amount of time. There again is no reason for the assumption that fair fees cannot be demanded for this type of service. John Wanamaker once said, "The price is soon forgotten if the quality remains."

Dentistry will rise to great heights only when the average patient reaches old age with a natural denture still healthy enough to enable him to enjoy eating. Let us be meticulous in our operative procedures. Let us become specialists in prevention.[24] That is consistency.

13859 Euclid Avenue.

19. Sweeney, J. T.: Amalgam Manipulation. Manual Versus Mechanical Aids. Part 2. Comparison of Clinical Applications. J.A.D.A. 27:1940, December 1940.

20. Sweeney, J. T.: Improved Technic for Packing and Condensing Uniform Amalgam Restorations by Hand. J.A.D.A. 28:1463, September 1941.

21. Orban, Balint: Biologic Considerations in Restorative Dentistry. J.A.D.A. 28:1069, July 1941.

22. Stillson, W. C.: Interdentium. J. Ohio D. Soc. 17:119, August 1943.

23. Prime, J. M.: Inconsistencies in Operative Dentistry. J.A.D.A. 24:82, January 1937.

24. Blackwell, R. E.: Prevention in the Practice of Operative Dentistry. J.A.D.A. 29: 196, February 1942.

TREATMENT OF VINCENT'S INFECTION

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There is a considerable element of mystery surrounding the disease entity known generally to dentists as Vincent's infection. The etiology is still obscure, being made up of a variety of predisposing factors which prepare for the onslaught of the exciting organisms. An excellent chapter, by Rosebury, reviewing all the etiologic factors, predisposing and exciting, appears in Gordon's "Dental Science and Dental Art."[1] Suffice it to say here that the exciting organisms are commonly believed to be *Fusiformis dentium* and *Borellia vincenti*. There is now evidence that the presence of at least two other organisms is necessary, a vibrio (viridans?) and a streptococcus. All of these organisms are strictly anaerobic and are grown in the laboratory on artificial media only with difficulty.

These organisms are called normal inhabitants of the mouth, being constantly found in a great variety of conditions that are not necessarily Vincent's infection. Hence, it is said that these organisms are opportunists in that, when the right combination of predisposing conditions exists, they proliferate and invade the soft tissues, typical necrotic, ulcerative, punched-out lesions resulting. A recent study[2] suggests the possibility of mistaking other spirillary forms for *Bor. vincenti*, and so throws some doubt on the "normal" presence of this species in the mouth. The infection may therefore be much more specific.

To make the problem of etiology even more complicated, it is believed possible that the presence of a virus may serve to predispose the oral tissues to typical necrotic ulceration. A syndrome has been described[3] to which has been applied the term acute infectious gingivostomatitis. It was indicated that this syndrome is identical with what dentists call Vincent's infection. The clinical description of this disease makes mention of vesicles which appear on the mucous membrane or gingivae, but which develop away from the free gum margins. These vesicles have been definitely proved to contain herpes simplex virus; consequently, this disease is said to be of this specific virus etiology. The appearance of vesicles differentiates this syndrome from that commonly called Vincent's infection and a careful differential diagnosis must be made. This differential diagnosis of herpetic infection is clearly outlined by Ziskin and Holden.[4]

Regarding transmissibility, the difficulty of culturing the organisms makes the idea of contagion by way of drinking glasses and eating utensils untenable. Similarly, the discarding of toothbrushes is not necessary. The brush should be exposed to air between brushings to kill any organisms. Contacts as intimate as kissing might possibly transmit the disease. If we are logical in our advice to

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1. Gordon, S. M. (editor): Dental Science and Dental Art. Philadelphia: Lea & Febiger, 1938, p. 415.

2. Hampp, E. G.: Comparative Study of Dark-Field and Stained Smear Technics for Identification of Oral Spirochetes on Basis of Morphologic Characteristics. J.A.D.A. 32: 318-324, March 1, 1945.

3. Black, W. C.: Etiology of Acute Infectious Gingivostomatitis (Vincent's Stomatitis). J. Pediat. 20: 145-160, February 1942.

4. Ziskin, D. E., and Holden, Margaret: Acute Herpetic Gingivostomatitis: Report of Fifteen Cases. J.A.D.A. 30: 1697-1705, November 1, 1943.

patients, we urge the same sanitary precaution as for upper respiratory infections.

Treatment

1. *Arsenicals.*—It is believed that arsenical therapy plays no part in the treatment of this disease. In the literature,[5-8] numerous instances have been cited of cases of arsenotherapy for syphilis attended by intercurrent attacks of Vincent's infection, continuation of the arsenical therapy complicating treatment of the oral disease. Further, the oral disease does not seem to improve under treatment with arsenicals.

A woman, aged 30 years, called the clinic saying that she had "toothache." When seen the same day, the whole proximal space between the lower right lateral incisor and cuspid was filled with a blood clot. This area was syringed thoroughly to remove the clot. The sides of the adjacent teeth were scaled to remove calculus, which was heavy. On removal, it was found that the interproximal septum of bone was completely denuded of all soft tissue. The area was packed with a surgical paste of the zinc oxide-eugenol variety.

The patient reported two days later and a definite diagnosis of generalized Vincent's infection was made. Applications of crystal violet-brilliant green (equal parts) were made on the right side, upper and lower, and neutral acriflavine 1:1,000 was used on the left side. This therapy was continued until an ulceration developed in the right tonsillar region, which was treated with silver nitrate (30 per cent aqueous), and the patient was referred to the dermatology clinic for arsenical therapy. A total of three injections of mapharsen,* spaced a week apart, were administered.

During treatment and observation, the patient was being followed in the prenatal clinic. On March 16, 1944, after she had received her last mapharsen injection, the attending dermatologist made a note "mouth markedly improved." On the same day, she was seen in the prenatal clinic. The attending obstetrician made a note to the effect that the "mouth shows minimal improvement," in which the dentist concurred. At this time, the dentist decided that all the above-mentioned therapy had been ineffective and intensive subgingival curettage was instituted. Three curettements, March 25 and 27 and April 6, 1944, served to restore the mouth to a healthy condition, which has persisted since.

2. *Dyes.*—The case cited also indicated the general response of Vincent's infection to treatment with dyes. The author was brought up, so to speak, in dental school, on the use of neutral acriflavine. This dye had been a part of the routine treatment until recently, when a definite allergic reaction or idiosyncrasy was encountered in another patient.

The latter patient presented a generalized Vincent's infection of moderate severity. Routine treatment consisted of subgingival curettage to remove the more obvious accretions and some of the necrotic débris from the interproximal spaces. After curettage, small pledgets of cotton were soaked in neutral acriflavine and pushed through the interdental spaces. The patient was seen about the middle of the morning. By noon, she noticed a puffiness of the face, especially in front of the ears. A patch test on the arm, using a small square of gauze moistened with neutral acriflavine, showed a definite erythematous area in a few hours.

Treatment of the gingivitis was con-

5. Sutton, I. C.: Vincent's Angina Occurring in Patient Under Treatment for Syphilis. J.A.M.A. 83:1919, December 13, 1924.

6. Jewesbury, E. C. O.: Misuse of Intravenous N.A.B. (Arsenicals) for Vincent's Infection. Brit. M. J. 2:360-362, September 18, 1943.

7. Field, Henry, Jr.: Therapy of Fusospirochetosis (Vincent's Disease). Pharmacopea and Physician. J.A.M.A. 114:1073-1077, March 23, 1940.

8. Lichtenberg, H. H.; Werner, Marie, and Luek, E. V.: Pathogenicity of Fusiform Bacillus and Spirillum of Plaut-Vincent's. J.A.M.A. 100:707-711, March 11, 1933.

*Not accepted by the Council on Dental Therapeutics.

tinued without the acriflavine, all other procedures being the same, with continued steady improvement, until the gingival crests were again everted and the case dismissed.

3. *Oxygen-Liberating Drugs.*—The reports of the ill effect in some persons of the use of sodium perborate[9, 10] and the guarded attitude of the Council on Dental Therapeutics[11] prompt us to eliminate this drug from our armamentarium. The possibility, always present, of a chemical burn does not warrant the use of sodium perborate. Even hydrogen peroxide has not proved to be indispensable, for cases are now being treated with hot saline irrigations with responses seemingly as prompt.

4. *Local Treatment.*—The most essential part of the treatment is subgingival curettage. Cases respond markedly after curettage, sometimes within twelve hours, whether or not any adjunctive therapy is used. Twenty-four hours after the initial curettage, the gingival crests are definitely less inflamed, the necrotic areas and those covered by pseudomembrane have receded and the patient is much more comfortable.

This curettage is not vigorous and thorough at first, scalers being used to remove the most obvious and largest accretions. Light superficial scaling may be instituted the first time that the patient is seen. The cardinal surgical principle of gentleness to tissues applies here emphatically. Care must be exercised not to traumatize the gums by vigorous removal of all subgingival deposits. Occasionally, cases are seen in which there is little supragingival calculus. Even here, a careful, deft technic will allow the removal of some of this accretion. Relief of much of the gingival irritation in this way will allow the tissues to begin to heal. The response of cases does not indicate that a surgical aseptic technic is necessary, but ordinary surgical precautions for cleanliness are desirable.

After curettage, small pledgets of cotton soaked in any mild antiseptic are pushed through the interdental spaces, with the tine of a cowhorn explorer, to remove more of the necrotic débris.

The patient should be seen at forty-eight to seventy-two hour intervals, the time depending on the acuteness and severity of the case, to continue scaling. At each sitting, a little more of the calculus is removed, until the necks of the teeth are free of accretions. It has been observed that deposits form again rather rapidly, and this continued scaling will also remove them.

It is believed that the scaling manipulation removes considerable necrotic, infective débris. Several cases have been treated, subsequently to the initial scaling, merely by pushing the cotton pellets through the interdental spaces when it was believed that most of the accretions had been removed. All these cases gradually relapsed, only to respond promptly when curettage was again instituted.

After the acute symptoms have subsided, treatment must be continued until the interdental gingival crests have again everted and filled the interproximal spaces. All sources of gingival irritation must be eliminated, including sharp cavity margins, overhanging filling margins, retained root fragments, ill-fitting prosthetic appliances, malalined teeth that allow food impaction and partially erupted third molars. The patient must be impressed with the fact that recurrence is inevitable unless mouth rehabilitation is complete. This rehabilitation includes, in addition to the foregoing, training in the use of the toothbrush.

9. Miller, S. C., et al.: Hydrogen Peroxide and Sodium Perborate; Comparative Oral Irritant Action. J.A.D.A. 25:1957-1973, December 1938.

10. Glickman, Irving, and Bibby, B. G.: Effect of Sodium Perborate upon Gingival Mucosa: Controlled Experiment. J.A.D.A. 31:1201-1211, September 1, 1944.

11. Accepted Dental Remedies, Ed. 10. Chicago: American Dental Association, 1944, p. 166.

With most patients, the toothbrushing has been attended to rather desultorily. An actual toothbrush and a demonstration model are invaluable in demonstrating correct manipulation.

As the tissues heal, the patient should also be trained in the use of floss in keeping the interproximal spaces clean. He should be cautioned not to snap the floss through the contacts by holding it horizontally, but should ease it through while holding it at an acute angle to the occlusal plane. The floss should then be used merely to wipe out the accumulated débris, a slight sawing motion carrying the loose material out from the interdental space. The floss should not be used as a polishing device at the contacts or on the necks of the teeth.

We have not used any of the various forms of interdental stimulators. Our experience with floss seems to indicate that cleanliness is the important factor in completing the cure. The regular cleansing of the interdental area often makes the difference between "cured" and "almost cured."

Summary

The etiology of ulceromembranous gingivitis is still quite obscure. No attempt has been made to discuss it, except to point out that, in addition to the notorious *Fusiformis dentium* and *Borellia vincenti*, there are at least two other organisms the presence of which is necessary. There is some speculation also as to the role of a virus as a predisposing factor. It is concluded that a Vincent's infection of virus etiology is probably a different disease entity.

The use of arsenicals has not been found to alleviate the oral infection. Similarly, the local application of dyes has not been observed to alter the course of the disease. The use of sodium perborate is definitely not recommended because of the ever-present possibility of chemical burn.

It is pointed out that healing is much more rapid and more nearly complete when dependence is placed on subgingival curettage rather than on the use of drugs. This curettage, or light scaling, is effective in relieving discomfort within twenty-four hours. The tissues are healing well within forty-eight hours. Rather than spreading the infection, the scaling breaks the vicious circle of gingival irritation, infection and calculus formation, and allows the tissues to heal.

Complete mouth rehabilitation and adequate instruction in oral hygienic habits are important in preventing recurrence.

In conclusion, it must be pointed out that the treatment of Vincent's infection is definitely a dental problem. When an infection of similar etiology and similar clinical appearance invades other parts of the body, the problem is the physician's.

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AMERICAN DENTAL ASSOCIATION

Harold Hillenbrand, D.D.S., Editor
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SELF-HARDENING LINERS FOR FULL OR PARTIAL DENTURES

The increased use of liners for dentures has led to a study of these materials, which are found to be essentially solutions of resin or highly plasticized resin. Skinner and Pomés,[1] reporting about a year ago, found that the solvents used were likely to be irritating, that the denture base was softened after the liner was applied, that from twenty to thirty days were required for the liner to harden, the liner never becoming as hard as the denture resin itself, and that the liner shrinks on hardening, causing the denture to warp toward the lined side. They concluded that "no lining material can be satisfactory that contains a solvent for the denture base material, unless the denture and liner are held rigidly under pressure during the curing or hardening process."

The American Dental Association Research Fellows at the National Bureau of Standards, in response to inquiries made of the Bureau and of the Research Commission of the American Dental Association, undertook a further study of these materials.[2] This study, which includes the opinions of competent prosthodontists, concludes that "with current materials used as directed the profession is paying an exorbitant price for a product of questionable utility."

In this study, Beall and Caul found that all liners were essentially solutions of methyl methacrylate resin in a solvent such as ethyl acetate, amyl acetate, triacetin or diethyl carbonate. Of these, only one would be likely not to produce irritation when used on the tissues of the mouth. As the material hardens, these solvents are discharged and they are still being lost rapidly when the lined denture is given to the patient. As the solvent is lost, there is a shrinkage of the denture base which causes the base to warp toward the lined side. It was also found that, four hours after the liner was applied, there was a loss of strength, varying from 13 to 34 per cent, in the original denture base. This indicates that the denture base, even with the additional

1. Skinner, E. W., and Pomés, Carlos E.: Self-Hardening Lining Materials. J.A.D.A. 32:419, April 1, 1945.

2. See page 304 of this issue.

thickness of the liner, is not as strong as the unlined base. It also tends to show that the liner does not actually become a part of the denture, as has been claimed in some advertising copy. When the liner and the denture base were compared for hardness under controlled temperatures, the liner was found to be softer than the resin even though the liner had been "hardening" for as much as a month and a half. Evidence of wrinkling and discoloration in the lining material was also found.

Of those who reported their clinical experience with lining materials, 88 per cent found irritation of the mouth tissues for short periods; 85 per cent reported that the surface of the liner became unsatisfactory after six months or more of use; all reported an improved fit immediately after lining, but 50 per cent questioned that improvement after six months; 50 per cent noted a disturbance in the occlusion of the lined denture. Seventeen clinicians reported that their experiences had led them to classify these materials as "temporary," one classified them as "permanent" and eight classified them as "entirely unsatisfactory."

The authors also found that the cost of the resin and solvent "may vary from 3.7 cents to 33.2 cents for packages of material that retail for from $5 to $15." These figures do not include the cost of packaging, labor, profit or other items of overhead, but the gap would seem to be excessive when compared with toothpaste, which, it is pointed out, is sold "in equivalent packages for 35 to 50 cents retail."

Further research, as Beall and Caul point out, may reveal improved technics or application or make possible the elimination of the solvent and the subsequent distortion of the denture base. On the basis of present evidence, the use of liners should be discontinued as a "permanent" service to the patient, and other uses should be approached cautiously in the light of these facts.

THE PRESIDENT'S HEALTH PROGRAM AND THE NEW WAGNER-MURRAY-DINGELL BILL

Enough time has elapsed since President Truman sent his message on health to Congress November 19, so that its purpose and impact can be estimated. It is now apparent that the message was drafted for the President by the same advisers who developed the formula for the third Wagner-Murray-Dingell Bill, introduced into both houses on the day that the presidential program was announced. It is also apparent now that the new bill was changed in several respects, only to make possible its referral to more favorably inclined committees in both the House and the Senate. This maneuver was successful, and it is to be expected that hearings will soon be held by the Senate Committee on Education and Labor, of which Senator James E. Murray, one of the sponsors of the bill, is chairman. These hearings undoubtedly will be used to bring about a renewed public discussion in the hope that public demand will cause legislators to do something about a health measure that has at least twice before won studied indifference from many members of the Congress.

The American Dental Association will oppose the new Wagner-Murray-Dingell Bill, but not because it favors the status quo, not because it believes that legislation is unnecessary and not because purely professional interests are said to be endangered. The American Dental Association will oppose the Wagner-Murray-Dingell Bill because, quite simply, it is not good legislation for the establishment of a sound dental program in this country.

The American Dental Association, however, is not content with mere opposition. It has already sponsored two bills which it believes will constitute a more constructive effort toward improved dental health than this, or any other, Wagner-Murray-Dingell Bill. In order to make this point very clear, it is necessary to examine some other aspects of this problem.

Previous Legislation.—The Social Security Act of 1935 did not contain provisions for a national health program, as it might reasonably have been expected to do. The first effort to amend that act in this regard came in 1939 with the introduction of the first Wagner Health Bill. At that time, the American Dental Association expressed itself as wholly in sympathy with the objectives of the bill but opposed the mechanism established by it. Recognizing the extent of the dental problem in this country and realizing, also, the need for federal aid in its solution, the Association then proposed amendments to the bill. These amendments proposed grants-in-aid to the states in order to foster (1) dental research, (2) dental health education and (3) dental care, particularly for children. They were formally presented to Congress, but the bill was allowed to lapse by the administration. In an effort to initiate this constructive plan for improved dental health, the Association subsequently introduced two bills to realize the first part of its program—intensified dental research. Despite the firm backing of the Association, these bills were not passed by both houses of Congress, though achieving favorable votes in one.

These points are made at some length merely to indicate that the American Dental Association recognized the dental problem long before the Selective Service examinations brought tardy official and public attention to its importance, and that the Association moved consistently forward with a program of its own even when the threat of adverse federal legislation did not exist.

Further Developments.—Later, in an effort to define its attitude unmistakably, the House of Delegates of the American Dental Association unanimously approved the four following principles:

1. Research: Adequate provisions should be made for research which may lead to the prevention or control of dental diseases.

2. Dental Health Education: Dental health education should be included in all basic educational and treatment programs for children and adults.

3. Dental Care: (*a*) Dental care should be available to all, regardless of income or geographic location.

(*b*) Programs developed for dental care should be based on the prevention and control of dental diseases. All available resources should first be used to provide adequate dental treatment for children and to eliminate pain and infection for adults.

(*c*) Dental health is the responsibility of the individual, the family and the community, in that order. When this responsibility, however, is not assumed by the community, it should be assumed by the state and then by the federal government. The community in all cases shall determine the methods for providing service in its area.

4. In all conferences that may lead to the formation of a plan for dental research, dental health education and dental care, there should be participation by authorized representatives of the American Dental Association.

This clear enunciation of the Association's basic belief was followed by the introduction of two bills into Congress to translate the three-point program into reality.

A. D. A. Legislation.—S. 190 and H.R. 3816 were introduced into Congress by Senator James E. Murray, Montana, and Representative J. Percy Priest, Tennessee. These bills were sponsored by the American Dental Association in order to implement

the first point of its program: intensified dental research. The bills provide for the appropriation of federal funds to permit (1) the erection of a National Institute for Dental Research as an integral part of the National Health Institute near the nation's capital and (2) grants-in-aid to public and private agencies for the intensification of dental research.

S. 1099 was introduced by Senators Claude Pepper, Florida, and George D. Aiken, Vermont. Companion bills, H.R. 3412 and H.R. 3414, were introduced by Representatives Walter E. Brehm, Ohio, and Philip A. Traynor, Delaware. These bills are an essential complement of the research bills, since they incorporate provisions for the second and third points of the American Dental Association program. These bills, when enacted, will make federal grants-in-aid available to the states and their subdivisions for programs of dental health education and dental care. These grants would be administered and controlled largely by the states and subdivisions themselves under the broad program of the U. S. Public Health Service. In designing its program, the U. S. Public Health Service would have the counsel of an advisory board, the majority of which must be dentists according to the terms of the bill.

This legislation has certain other important characteristics. Its provisions are almost identical with the provisions of legislation which have made the national campaigns against cancer, venereal disease and tuberculosis so effective. It approaches the entire problem of dental health on an experimental basis and does not attempt to impose upon the country an untried, questionably designed program which the states would have very little power to alter or control. Through this bill, experiments can be conducted in the many phases of this problem for which data are now almost entirely absent; these experiments will be set up and carried out by the state and community which have a knowledge of their own needs as well as definite desires as to how these needs should be met.

This legislation must be compared with the Wagner-Murray Dingell Bill, which proposes an untried, compulsory, illusory, administratively-costly scheme for the entire country. The House of Delegates of the American Dental Association has repeatedly declared itself against a national system of compulsory health insurance in which dentistry is included. This opposition is not based on reaction but solidly on the fact that no country which has tried this scheme has ever materially improved the dental health of its people or the character of the dental service rendered. It is also based on the undeniable fact that a national system of compulsory sickness insurance negates the traditional right of a state to meet its own needs in its own way.

The American Dental Association and its numerous component and constituent societies have labored for many years to focus national attention on the size and the importance of the problems of dental health. It has made its counsel and the results of its studies available to every agency interested in the matter. It has enunciated its own program and pioneered in legislation to establish it. There is no good reason why these carefully constructed gains should be sacrificed now by yielding to the inferior proposals of the Wagner-Murray-Dingell Bill. There is still less reason for capitulating to legislation that gives little promise of fostering real improvement in dental health, merely because it has considerable vocal support.

The Wagner-Murray-Dingell Bill, in short, is not as good dental legislation as that proposed by the American Dental Association. These two Association bills should be vigorously pushed toward enactment by all of the resources of the profession aided by an informed public opinion. Only in this way can the maneuvering of those who toy with the national health by contradictory and purely tactical proposals be ended.

REPORTS OF COUNCILS AND COMMITTEES

COMMITTEE ON ECONOMICS

SURVEY OF DENTAL HYGIENISTS IN MASSACHUSETTS

The survey[1] of the characteristics, productivity and income of dental hygienists in the state of Massachusetts provides valuable and revealing information concerning this auxiliary group. The survey was based on reports received from 221 of the 475 known hygienists practicing in Massachusetts, or about 47 per cent of the total number. Of this number, 18.4 per cent were employed on a salary and commission basis, while 51.5 per cent were employed on a straight salary basis. Except for 6.3 per cent employed by civil service and 4.6 per cent serving in the armed forces, the remaining number of hygienists were practicing in clinics; namely, 13.5 per cent in school clinics, 1.3 per cent in school clinics and in private practice, 2.2 per cent in hospital clinics and 2.2 per cent in other clinics. The small number of hygienists in each of the last two categories raises a question concerning the reliability of the distribution.

Of special interest are the data concerning the number of prophylaxes performed and the time required. The report stated: "From this study, it may be realized that the average dental hygienist performing 1,325 prophylaxes per year, requiring at least forty-five minutes each, contributes 975 chair hours to the annual output of the dentist by whom she is employed." The average number of prophylaxes rendered by the hygienist per month amounted to 115. This required an average of forty-five minutes' time for each adult and twenty-eight minutes' time for each child, resulting in a saving of seventy-one chair hours monthly for dentists employing hygienists. Hygienists in private practice spent more time on prophylaxes than did those in clinics. The report indicated that the former group averaged thirty minutes for child prophylaxes, while the latter group spent between twenty-five and thirty minutes on the same services. The difference was more noticeable on adult prophylaxes, with those in private practice averaging about fifty minutes and hygienists in clinical practice averaging forty-three minutes. A large percentage also performed other duties: 13.6 per cent did some laboratory work, 64.5 per cent did general assisting and 37.1 per cent rendered surgical assistance to the dentist.

The study included revealing statistics on the number of years of service of hygienists. The author observes:

> The number of years of work expectancy of the dental hygienist is difficult to determine, but a generalization can be made from the figures showing years of service, years with present employer and number of years since graduation. The average hygienist has given 9.9 years of service, has been 5 years with her present employer, and has held 2 positions since graduating 9.9 years ago. The average age of the employed dental hygienist is 30 years, and her age at graduation was 20 years. From these figures one could assume that the number of years of work ex-

1. Wilkins, Esther M.: 1945 Survey of Dental Hygienists in Massachusetts. J. Am. Hygienists' A. 20:17, January 1946.

pectancy might be nearly 10 years. This is contrary to the belief of many dentists that there is a constant turnover in employment. Of the total surveyed, 31.9 per cent are married, a percentage which is influenced by wartime conditions.

The age of the hygienists in the sample ranged from 20 to 55 years, with almost 60 per cent under 30. In more exact terms: 38.2 per cent of the hygienists were between 20 and 25 years, while 21.5 per cent were between 26 and 30 years of age. The study indicated that, as age increased, the number of hygienists gradually decreased until the group between 46 and 55 years included only 5 per cent of the group.

The average annual income of 211 dental hygienists in the study was $1,769.90, ranging from an average of $1,666.45 for hygienists employed in school clinics to an average of $1,948 for hygienists employed in civil service. Hygienists employed in private practice without commission averaged $1,691.96, and those employed with commission arrangements averaged $1,885.63. Of the group surveyed, 22.7 per cent of the hygienists received between $1,401 and $1,600, while 31.4 per cent earned between $1,801 and $2,000. Just over 16 per cent of the hygienists received between $2,001 and $2,500. Half of the hygienists employed in civil service were in the latter group. Only 1.6 per cent of the entire group earned more than $2,500 annually.

Just over 70 per cent of the Massachusetts hygienists reporting had an average increase of $6.04 per week in the past two years. About 22 per cent of the hygienists reported that they were dissatisfied with their positions, mainly because of long hours and low pay. For an average weekly income of $34.28, the average hygienist worked an average of forty-two and one-quarter hours a week, or seven and one-quarter hours daily. Those in private practice on straight salary received a weekly compensation of $32.82 for working forty-three hours, or seven and three-quarters hours daily, while hygienists with commissions were paid a weekly salary of $36.73 for working the same number of hours.

Discussing the educational interest of hygienists, Miss Wilkins says:

> It is agreed among a majority of graduates that a one-year course is insufficient for preparing the hygienist at this time when the science of dentistry is becoming more and more complex. Fifty-one per cent of our hygienists have taken a variety of courses in the past two years, some of these for degree credit.

More than 90 per cent of the hygienists surveyed indicated an interest in taking additional courses.

The author concludes:

> The dental hygienist will have a definite place in any program designed to meet the demand of the public for better and more complete dental care. The health service rendered the patient is of primary importance when considering the implications of this survey. The specific work, that of prevention of oral disease by prophylactic treatment of the teeth and surrounding tissues, is a service to which the average dental practitioner cannot devote sufficient time. This contribution, together with the opportunities offered for teaching the principles of good dental health, refers alike to all fields of practice of the dental hygienist. The effectiveness of the work is dependent to a certain extent on the appreciation by the dentist of the value of the services performed under his supervision. . . . Through the continued personal and group efforts to improve the status of the dental hygiene profession, full recognition of the value of the services of the hygienist will be realized.—*J. E. Bagdonas.*

COUNCIL ON DENTAL THERAPEUTICS

ACCEPTED DENTAL REMEDIES

The Council on Dental Therapeutics of the American Dental Association announces the inclusion of the following articles in the list of Accepted Dental Remedies:

Anesthetics—Local[1]

Procaine HCl 2%, Epinephrine 1:25,000: Each cubic centimeter is stated to contain procaine hydrochloride, U.S.P., 0.02 Gm.; epinephrine, 0.00004 Gm.; sodium chloride, 0.0045 Gm.; sodium bisulfite, 0.0020 Gm., and distilled water.

Procaine HCl 2%, Epinephrine 1:50,000: Each cubic centimeter is stated to contain procaine hydrochloride, U.S.P., 0.02 Gm.; epinephrine, 0.00002 Gm.; sodium chloride, 0.0045 Gm.; sodium bisulfite, 0.0020 Gm., and distilled water. Marketed in cartridges, 1.8 cc. and 2.4 cc. Manufactured by the Graham Chemical Company, Jamaica, N. Y.

Procaine HCl 2%, Epinephrine 1:25,000.

Procaine HCl 2%, Epinephrine 1:50,000: Composition: See Graham Chemical Company. Distributed by the Ethical Dental Products Company, New York, N. Y.

Procaine HCl 2%, Epinephrine 1:25,000.

Procaine HCl 2%, Epinephrine 1:50,000: Composition: See Graham Chemical Company. Distributed by the Gold Dental Supply Company, Cincinnati, Ohio.

Procaine HCl 2%, Epinephrine 1:30,000: Each cubic centimeter is stated to contain procaine hydrochloride, U.S.P., 0.02 Gm.; epinephrine, 0.000033 Gm.; sodium chloride, 0.0045 Gm.; sodium bisulfite, 0.0020 Gm., and distilled water. Marketed in cartridges, 1.8 cc. and 2.4 cc.

Procaine HCl 2%, Epinephrine 1:50,000: Composition: See Graham Chemical Company. Distributed by the Guterman Dental Supply Company, New York, N. Y.

Zinc Oxide-Eugenol Cements[2]

Zinc Oxide-Rosin-Eugenol Temporary Cement (Anodyne)-Caulk: Powder: Each one hundred grams is stated to contain zinc oxide, 69.65 Gm.; hydrogenated rosin,[3] 29.85 Gm.; zinc acetate, 0.5 Gm. Liquid: Each one hundred grams is stated to contain eugenol, 82.1 Gm.; corn oil, 17.9 Gm. Manufactured by the L. D. Caulk Company, Milford, Del.

Dentifrices[4]

Varady Tooth Paste: Composition: See Milk-I-Dent Dental Cream. Manufactured by Trade Labs., Inc. Distributed by Varady Cosmetics, Inc., Newark, N. J.

Watkins Tooth Paste: Composition: Each one hundred grams is stated to contain precipitated calcium carbonate (Sturge No. 50), 36.7 Gm.; glycerin, 22.8 Gm.; magnesium hydroxide, 7.5 Gm.; gum tragacanth, 0.56 Gm.; soap, 1.13 Gm.; water, 30.6 Gm.; saccharin, 8 mg., and flavors (oil of peppermint, oil of spearmint, methyl salicylate, geraniol, oil of cloves and oil of pimento), 0.7 Gm. Manufactured and distributed by the J. R. Watkins Company, Winona, Minn.

1. A.D.R., Ed. 11, p. 39.

2. A.D.R., Ed. 11, p. 214.
3. A.D.R., Ed. 8, p. 191.
4. A.D.R., Ed. 11, p. 93.

Admission of a product to the list of Accepted Dental Remedies means that the product and the methods by which it was marketed at the time of consideration were not found to be in violation of the Council's published rules. Accepted products are reconsidered periodically. The files of the Council contain information on many drugs and dental cosmetics which is available upon request, and inquiries are welcomed.—*Donald A. Wallace, Secretary.*

NOTICE OF JUDGMENT

1306. Adulteration and misbranding of Dr. Hubbel's Formula for Dental Hygiene. U. S. v. Hubbel Products Corporation. Plea of guilty. Fine, $50. (F.D.C. No. 12597. Sample No. 52281-F.)

On November 6, 1944, the United States attorney for the District of Massachusetts filed an information against the Hubbel Products Corporation, Boston, Mass., alleging shipment of a quantity of the above-named product from the State of Massachusetts into the State of Maine, on or about March 11, 1944.

The article was alleged to be adulterated in that its strength differed from that which it purported and was represented to possess, since it was represented as containing 8 grains of chloral hydrate to the fluid ounce, whereas it contained approximately 14 grains of chloral hydrate to the fluid ounce.

It was alleged to be misbranded (1) in that the statement on its label, "Chloral Hydrate 8 grs. to Fluid Oz." was false and misleading; (2) in that its label bore no statement of the quantity of the contents; (3) in that its labeling bore no directions for use; and (4) in that it was a drug for use by man, and it contained chloral hydrate, a derivative of chloral, which derivative, by regulations, has been designated as habit-forming, but the label of the article did not bear the name and quantity or proportion of the derivative and, in juxtaposition therewith, the statement, "Warning—May be habit-forming."

On December 27, 1944, a plea of guilty having been entered on behalf of the corporation, the court imposed a fine of $25 on each of two counts, making a total fine of $50.

COMMITTEE ON INTERNATIONAL RELATIONS

REPORT OF LECTURE TRIP TO LATIN AMERICAN COUNTRIES

In 1945, Dr. Victor H. Sears, Salt Lake City, visited twelve Latin American countries for the purpose of giving classes and lectures. The trip, which extended from February 16 to June 5, was made under the auspices of the Committee on International Relations. Excerpts from a report made by Dr. Sears follow:

Classes and lectures were given in Spanish in the following countries: Mexico, Guatemala, Costa Rica, Panama, Colombia, Peru, Chile, Argentina, Uruguay, Brazil, Venezuela and Cuba. Everywhere the prestige of the American Dental Association was found to be high, and it is very likely that there can be a gain in the roster of Pan-American members.

Many dentists from the Latin American countries are planning to visit the United States as soon as conditions permit. Many are studying English in preparation for their proposed visits. More so, perhaps, than in our own country, the dentist in Latin America is a highly respected citizen with unmatched

Dr. Victor H. Sears lecturing during his Latin American visit.

opportunities for influencing public opinion. It is freely admitted, however, that dentistry in Latin America is below the standards in the United States. In many of the countries, dentistry is still dominated by medicine, but there is a general trend toward independence. Since most of the dental schools are government owned, this progress is largely a matter of legislation.

Latin American dental journalism is improving in all respects. Some of the journals still carry the advertising of products which the profession does not endorse, but they point out that such advertising is also carried by periodicals in this country. Dental school organization leaves much to be desired. In some schools, there are no department heads and, in others, teachers of equal rank have conflicting assignments. Salaries are very nominal and, as a result, teaching is frequently an avocation for purposes of prestige. Faculties are built almost entirely around graduates of the individual school. Tenure of office frequently depends on political affiliation.

The best dental schools, in general, are government owned and have low tuition rates. In some cases, there is no tuition charge. In some of the schools, almost half of the student body is composed of girls, but the professional mortality among this group is high. New dental school buildings in Argentina, Uruguay and Cuba are well above the average in this country. Other countries have very modern buildings planned or under construction. The cost of such construction is usually met by lottery.

In Latin America, there is a trend toward dental supply cooperatives, stock being held by dentists and dental laboratories. Some of these cooperatives plan to manufacture their own products, while others are already making products copied from United States designs. The latter has been made necessary, perhaps, by the difficulty of obtaining United States products in the various countries. Instruction to dental technicians is given in the dental schools by the regular teachers of the prosthetic courses.

"State" dentistry is being advanced

Dental College at Montevideo.

chiefly through the multiplication of independent dental clinics serving the families of government employes and in the public schools. In Venezuela and in Cuba, the law requires that every dentist be a member of the national dental society. Brazil also requires membership in the national association for all practicing dentists, but here there is some question of political control of the association.

Tentative plans have been made for a Pan-American Prosthetic Congress to be held in Mexico City in 1947.

Trips of this kind can be very effective in bringing the message of dentistry in this country to our colleagues in Latin America.

LIST OF NAVY DENTAL OFFICERS SEPARATED FROM SERVICE

The following officers have been separated from the Dental Corps of the U. S. Navy. This list is not complete. Publication will be given to other names as soon as possible.

	Alabama	
Birmingham	Cox, Harris R.	Lieut.
Brundidge	Floyd, Harold H.	
Greenville	Hagood, Joseph H.	Lieut.
	Alaska	
Juneau	Pyle, Taylor J.	Lt. Cmdr.
	Arizona	
Douglas	Causey, Joseph S.	Lt. Cmdr.
Tempe	Payne, Robert D.	Cmdr.
Tucson	Armstrong, C. F.	Lt. Cmdr.
	Arkansas	
Camden	Dietrich, Fred W.	Lieut.
Conway	Dunaway, F. E.	Lt. Cmdr.
Marion	McWherter, Earl	Lieut.
Siloam Springs	Stockton, J. L., Jr.	Lt. Cmdr.
	California	
Alameda	Brown, Theodore L.	Cmdr.
Balboa Island	Hartlein, John M.	
Berkeley	Mauk, Robert E.	Lt. Cmdr.
Berkeley	Thaddeus, Joseph V.	Cmdr.
Beverly Hills	Rosenblum, Jerome	Lieut.
Beverly Hills	Vance, Alva J.	Cmdr.
Beverly Hills	Vance, W. C.	Lt. Cmdr.
Burbank	Waggoner, Rex R.	Lt. Cmdr.
Carmel	McCabe, William H.	Lieut.
Castro Valley	Smisek, Edwin S.	Lt. Cmdr.
Coronado	Covington, W. E.	Lt. Cmdr.
Courtland	Carls, Robert P.	Lieut.
Escondido	Buell, Arthur B.	Lieut.
Garden Grove	Jesch, Norman H.	Lieut.
Inglewood	Curtis, Leslie B.	Lt. Cmdr.
Larkspur	McMurry, R. F.	Lt. Cmdr.
Long Beach	Koster, John E.	Lieut.
Los Angeles	Ader, Willis F.	Lieut.
Los Angeles	Baker, Harry C.	Lieut.
Los Angeles	Beazley, W. A.	Lt. Cmdr.
Los Angeles	Bonness, Walter	Cmdr.
Los Angeles	Christensen, Leslie E.	Lieut.
Los Angeles	Doughty, Walter M.	Cmdr.
Los Angeles	Galbraith, Hal N.	Lt. Cmdr.
Los Angeles	Helvoigt, K. A.	Lt. Cmdr.
Los Angeles	Hofferber, G. K.	Lieut.
Los Angeles	Keyes, Charles F.	Lt. Cmdr.
Los Angeles	Marill, Arthur Q.	Lieut.
Los Angeles	Markman, Leo	Lieut.
Los Angeles	Morrell, Robert X.	Lieut.
Los Angeles	Poor, Carlton C.	Lt. Cmdr.
Los Angeles	Reese, Robert H.	Lt. Cmdr.
Los Angeles	Rosen, Jack M.	Lt. Cmdr.
Los Angeles	Thomason, Harold J.	Cmdr.
Los Angeles	Vestermark, A. L.	Lt. Cmdr.
Monrovia	Nimmo, John M.	Lieut.
Montebello	Fritts, Ansalem V.	Lt. Cmdr.
Niles	Rathbone, John S.	Lt. Cmdr.
North Hollywood	Zukerman, W. A.	Lt. Cmdr.
Pasadena	Lincoln, Charles W.	Cmdr.
Pomona	Pepin, Ernest M.	Cmdr.
Roseville	Barusch, Leo	Lt. Cmdr.
San Bernardino	Adams, Carl W.	Cmdr.
San Bernardino	Page, Joe P.	Lt. Cmdr.
San Diego	Kervin, Delos R.	Lt. Cmdr.
San Diego	Moore, Joseph A.	Lt. Cmdr.
San Diego	Parks, Ivy W.	Cmdr.
San Francisco	Busch, Duane B.	Lieut.
San Francisco	Dahl, Lloyd H.	Lt. Cmdr.
San Francisco	Ginocchio, A. B.	Lt. Cmdr.
San Francisco	Klinge, Arthur H.	Lieut.
San Francisco	Morrison, Robert S.	Lieut.
San Francisco	Quigg, George T.	Lt. Cmdr.
San Francisco	Rheiner, R. N.	Lt. Cmdr.
San Jose	Rosenthal, Harold	Lieut.
San Jose	Zingheim, Thomas J.	Lieut.
San Marino	Quesnell, Reed A.	Lt. Cmdr.
San Marino	Sundbye, John G.	Lt. Cmdr.
San Mateo	Pearson, A. W.	Lt. Cmdr.
Santa Barbara	Martin, Niels H.	Cmdr.
South Laguna	Balzen, Adolf H.	Lt. Cmdr.
Stockton	Clegg, Harold E.	Lieut.
Stockton	Hall, Robert W.	Lt. Cmdr.
Stockton	Turner, Marshall C.	Lieut.
Walnut Creek	Shahbazian, Jack V.	Lieut.
West Hollywood	Brannan, Donald E.	Lieut.
	Colorado	
Boulder	Miller, Clarke N.	Lieut.
Denver	Giesecke, Lewis V.	Lieut.
	Connecticut	
Bridgeport	Johnson, Clifford G.	
Danbury	Murphy, William J.	Lieut.
Guilford	Gordon, Edwin V.	Lt. Cmdr.
New Britain	Maisel, James	Lt. Cmdr.
Niantic	Riley, Thomas J., Jr.	Lieut.
	District of Columbia	
Washington	Falls, Walker M.	Lieut.
Washington	Silverman, Stanley G.	Lieut.
Washington	Williams, E. V.	Lt. Cmdr.
	Florida	
Gainesville	Hussey, S. A., Jr.	Lt. Cmdr.
Hollywood	Miles, John P.	Lt. Cmdr.
Jacksonville	Scott, Francis T.	Lieut.
Lakeland	Paul, Townsend B.	Cmdr.
Miami Beach	Coleman, G. J.	Lt. Cmdr.
Miami Beach	Craig, Charles L.	Lt. Cmdr.
Miami Beach	Graves, W. F.	Lt. Cmdr.
Perry	Peacock, Wilburn H.	Lieut.
St. Petersburg	Stewart, Olad C.	Cmdr.
Tampa	Higginbotham, W.	Lt. Cmdr.

Georgia

Atlanta	Falls, Cicero B.	Lt. Cmdr.
Atlanta	Greene, Albert A.	Lt. Cmdr.
Atlanta	Jenkins, Albert E.	Lt. Cmdr.
Atlanta	Jones, B. F.	Lt. Cmdr.
Collegepark	Boggs, Lake S.	Lieut.
Leesburg	Martin, Ben M.	Lt. Cmdr.
Macon	Lee, James B.	Lt. Cmdr.

Idaho

Buhl	Baggs, William E.	Lieut.
Nampa	Edwards, M. W.	Lt. Cmdr.
Pocatello	Sutton, Bland W.	Lieut.

Illinois

Barry	Ownby, T. J.	Lt. Cmdr.
Benton	Dudley, G. E.	Lt. Cmdr.
Charleston	Brickman, Isidore W.	Lieut.
Chicago	Berkenstadt, E. J.	Lt. Cmdr.
Chicago	Boris, Henry L.	Lieut.
Chicago	Costello, Maurice	Lt. Cmdr.
Chicago	Fortelka, G. C.	Lt. Cmdr.
Chicago	Friedrich, Edward G.	Cmdr.
Chicago	Greenwald, J. L.	Lt. Cmdr.
Chicago	Harris, James S.	Lt. Cmdr.
Chicago	Hattendorf, D. F.	Lt. Cmdr.
Chicago	Havelka, R. G.	Lt. Cmdr.
Chicago	Hawkins, James F.	Lieut.
Chicago	Hejna, William	Lieut.
Chicago	Kelder, H. P., Jr.	Lieut.
Chicago	Kurth, LeRoy E.	Lt. Cmdr.
Chicago	Kurtz, William H.	Lieut.
Chicago	Lauren, Bernard S.	Lieut.
Chicago	Lieberman, Alvin	Lt. Cmdr.
Chicago	Logue, James R.	Lt. Cmdr.
Chicago	Lourie, Lloyd S.	Lieut.
Chicago	O'Grady, F. J.	Lt. Cmdr.
Chicago	Pollock, Sidney S.	Lt. Cmdr.
Chicago	Rix, James T.	Lt. Cmdr.
Chicago	Schriver, Rhinehart B.	Lieut.
East Peoria	Hartz, Wilson H.	Lt. Cmdr.
Evanston	Mitchell, Edward C.	Lieut.
Geneseo	Myers, John S.	Lt. Cmdr.
Hinsdale	Anderson, Axel G.	Lt. Cmdr.
Jacksonville	Bunch, Wyles B.	Lieut.
Jerseyville	Ritter, Philip A.	Lt. Cmdr.
Mattoon	Davidson, Kenneth D.	Lieut.
Morrison	Gronner, Curt J.	Lt. Cmdr.
Northbrook	Hedgcock, S. F.	Lt. Cmdr.
Oak Park	Del Rosso, Hugo T.	
Oak Park	Shearon, K. E.	Lt. Cmdr.
Park Ridge	Denneman, William F.	
Peoria	Elson, James M.	Lt. Cmdr.
Peoria	Gullett, W. I.	Lt. Cmdr.
Robinson	Griffy, Byrl W.	Lt. Cmdr.
Springfield	Donelan, John J.	Lieut.
Sterling	Behrens, Lee O.	Lieut.
Urbana	Rebman, L. W.	Lt. Cmdr.
Wheaton	Fry, George W.	Lt. Cmdr.
Woodstock	De Wolf, William H.	Cmdr.

Indiana

Columbus	Gainey, W. W.	Lt. Cmdr.
Indianapolis	Brant, Bridane W.	Lieut.
Indianapolis	Lilly, Albert J.	Lt. Cmdr.
Indianapolis	Quinn, Gilbert D.	Lieut.
Linton	Haworth, G. B.	Lt. Cmdr.
Michigan City	Hall, W. A., Jr.	Lt. Cmdr.
New Castle	Paul, Herbert	Lieut.
Vincennes	Wolfe, Herman B.	Lieut.
Washington	Burris, W. T.	Lt. Cmdr.

Iowa

Ames	Walsh, Eugene V.	Lt. Cmdr.
Columbus Jct.	Marker, D. A.	Lt. Cmdr.
Davenport	Sebolt, William O.	Lieut.
Des Moines	Eastman, Arthur D.	Cmdr.
Des Moines	Sommers, Everett J.	Lieut.
DeWitt	Clifford, Leo F.	Lieut.
Dubuque	Foster, Lawrence W.	Lieut.
Forest City	Hayden, C. B.	Lt. Cmdr.
Fort Dodge	Runge, Norman W.	Lieut.
Fredericksburg	Green, Olney D.	Lieut.
Kanawha	Tande, Syrus E.	Lt. Cmdr.
Keokuk	Bowlin, Richard H.	Lieut.
Ossian	Henry, Charles R.	
Schleswig	Jones, Robert H.	Lt. Cmdr.
Toledo	Hoffer, Martin H.	Lt. Cmdr.
Waterloo	Foster, Rex B.	Lieut.
Williamsburg	Lewis, Merlyn A.	Lt. Cmdr.

Kansas

Junction City	Bunker, Lorenz P.	Lt. Cmdr.
Lindsborg	Peterson, W. W.	Lt. Cmdr.
Mission	Oakleaf, Raymond H.	Lieut.
Topeka	Feeley, Newell O.	Lieut.
Topeka	Osborn, L. C.	Lt. Cmdr.
Yates Center	Culver, Herbert A.	Lieut.

Kentucky

Ashland	Dickenson, J. B.	Lt. Cmdr.
Lancaster	Bowling, Green A.	Lt. Cmdr.
Maysville	McDowell, John I.	Lieut.
Middletown	Keyes, James K.	Lieut.

Louisiana

Abbeville	Minvielle, J. E.	Lt. Cmdr.
Mansura	Tesca, R. R., Jr.	Lt. Cmdr.
Monroe	Strickland, D. A.	Lt. Cmdr.
New Orleans	Booth, Perry J.	Lieut.
New Orleans	Capo, John T.	Lt. Cmdr.
New Orleans	DiLeo, Carlo A.	Lt. Cmdr.
New Orleans	Edrington, Herbert S.	Lieut.
New Orleans	Kreller, A. J.	Lt. Cmdr.
New Orleans	Woodward, H. E.	Lt. Cmdr.

Maine

Augusta	Cheney, Leon A.	Lieut.
Portland	Anderson, P. W.	Lt. Cmdr.

Maryland

Baltimore	Heck, John C.	Lt. Cmdr.
Baltimore	McLeod, T. D.	Lt. Cmdr.
Elk Mills	Lawrence, Ronald	Lt. Cmdr.
Frederick	Myers, E. L., Jr.	Lt. Cmdr.
Harrisonville	Long, D. S., Jr.	Lt. Cmdr.

Massachusetts

Andover	Norton, S. H.	Lt. Cmdr.
Athol	Glaser, Samuel I.	Lt. Cmdr.
Belmont	Baldi, Alfred J.	Lt. Cmdr.
Belmont	Shangraw, K. A.	Lt. Cmdr.
Beverly	Carbone, S. L., Jr.	Lt. Cmdr.
Beverly	Wright, Edgar A.	Lt. Cmdr.
Boston	Doherty, J. A.	Lt. Cmdr.

Boston	Malone, R. G.	Lt. Cmdr.
Brookline	Rhodes, Frank I.	Lt. Cmdr.
Dedham	Bisbee, John B.	Lt. Cmdr.
East Boston	Greenslade, R. S.	Lt. Cmdr.
East Walpole	Norcross, W. C.	Lt. Cmdr.
Gardner	Ropulewis, J. F.	Lt. Cmdr.
Longmeadow	Richey, Robert M.	Lieut.
Lowell	Drapeau, W. R.	Lt. Cmdr.
Middleton	Mayne, James L., Jr.	Lieut.
New Bedford	Carvalho, A. R.	Lt. Cmdr.
Petersham	Martin, James M.	Lt. Cmdr.
Topsfield	Edwards, Roger J.	Cmdr.
Williamstown	Jerdon, E. J.	Lt. Cmdr.
Winchester	Millican, Robert G.	Cmdr.
Winchester	Pollard, E. M.	Lt. Cmdr.
Woburn	Sheeran, J. P.	Lt. Cmdr.
Worcester	Knight, Albert E.	Lt. Cmdr.

Michigan

Alpena	Meisel, Rhonald V.	Cmdr.
Birmingham	McNaughton, A. L.	Lieut.
Constantine	Comar, M. F.	Lt. Cmdr.
Detroit	Bellinger, Wright S.	Lieut.
Detroit	Black, Gerald S.	Lt. Cmdr.
Detroit	Brunk, Perry E.	Lt. Cmdr.
Detroit	Carr, Harry L.	Cmdr.
Detroit	Cobb, William J.	Lt. Cmdr.
Detroit	Hardies, W. H. F.	Lieut.
Detroit	Kanter, Norman E.	
Detroit	Meyers, Louis H.	Lieut.
Detroit	Plopa, Stanley C.	Lt. Cmdr.
Flint	Gross, Nat N.	Lieut.
Grand Rapids	Bolt, Orren A.	Lt. Cmdr.
Grand Rapids	Moore, Gerald W.	Lieut.
Grand Rapids	Strobel, Harold J.	Lieut.
Grand Rapids	Worsfold, G. R.	Lt. Cmdr.
Grosse Pointe Pk.	Christiansen, G. W.	Cmdr.
Lexington	Smalley, Maris L.	Lieut.
Mount Clemens	Robertroy, W. G.	Lt. Cmdr.
Pontiac	Klausmeyer, L. F.	Lieut.
Saginaw	Hickey, James P.	Lieut.
St. Johns	Oatley, H. L.	Lt. Cmdr.

Minnesota

Albany	Peternell, H. F.	Lt. Cmdr.
Austin	Leebens, William M.	Lieut.
Crookston	Jung, Harper F.	Lieut.
Hollandale	Pickell, Wayne D.	Lieut.
Minneapolis	Bloom, Harvey J.	Lieut.
Minneapolis	Boettcher, G. H.	Lt. Cmdr.
Minneapolis	Knechtges, Vinton W.	Lieut.
Minneapolis	Lange, Harold A.	Lieut.
Minneapolis	Nicol, John J.	Lt. Cmdr.
Minneapolis	Schaller, F. R.	Lt. Cmdr.
Minneapolis	Sorteberg, H. E.	Lt. Cmdr.
North St. Paul	Schaffer, G. A.	Lt. Cmdr.
Red Wing	Fleming, J. W.	Lt. Cmdr.
Redwood Falls	Inglis, James H.	Lt. Cmdr.
Rochester	Fawcett, Joseph C.	Lieut.
St. Paul	Maloney, John R.	Lieut.
St. Paul	Siemer, H. N.	Lt. Cmdr.
Sauk Rapids	Neils, Reinhard A.	Lieut.

Mississippi

Bay St. Louis	O'Brien, W. T.	Lt. Cmdr.
Canton	Wallace, N. H.	Lt. Cmdr.
Starkville	Hines, Wirt A.	Lt. Cmdr.

Missouri

Farmington	Kelin, Jones E.	Lieut.
Harrisonville	Long, D. S., Jr.	Lt. Cmdr.
Jefferson City	Drisler, J. H.	Lt. Cmdr.
Kansas City	Blender, L. A.	Lt. Cmdr.
Kansas City	Sterling, M. A.	Lt. Cmdr.
Kingsville	Tompkins, Jesse L.	Lieut.
Moberly	White, Dan B.	Lt. Cmdr.
St. Louis	Loddeke, Bernard H.	Lieut.
St. Louis	Lynch, Roy A.	Lieut.
St. Louis	Rinesmith, H. W.	Cmdr.
St. Louis	Wilson, William C.	Lieut.

Montana

Bozeman	Westlake, Francis G.	Lieut.
Hardin	Overland, G. M.	Lt. Cmdr.

Nebraska

Alliance	Burkett, Lyle M.	Lieut.
Lincoln	Akin, Frederick M.	Lieut.
Lincoln	Askey, Hollis A.	Lt. Cmdr.

New Hampshire

Kearsarge	Hubbard, G. R.	Lt. Cmdr.
Manchester	Bethell, Russel H.	Cmdr.
Nashua	Marion, G. O.	Lt. Cmdr.

New Jersey

Cradell	Schilling, L. R.	Lt. Cmdr.
Fairview	Montemurro, A. J.	Cmdr.
Jersey City	D'Elia, O. P.	Lt. Cmdr.
Mt. Holly	Robinson, S. A.	Lt. Cmdr.
Newark	Hemsath, Henry E.	Lieut.
Newark	Spector, Benjamin	Cmdr.
New Brunswick	McManus, E. F.	Lt. Cmdr.
Orange	Bolan, J. J., Jr.	Lt. Cmdr.
Orange	Cappeto, James J.	Lieut.
Orange	Linn, Bernard F.	Lieut.
Trenton	Raw, Lester	Lieut.
Weehawken	Moskowitz, B. A.	Lt. Cmdr.
West Caldwell	Fischer, H. H.	Lt. Cmdr.

New Mexico

Gallup	Love, James H.	Lieut.
Santa Fe	Rosen, J. P.	Lt. Cmdr.

New York

Baldwin	Sackett, Donald F.	Lieut.
Binghamton	Berry, George M.	Lt. Cmdr.
Binghamton	Decker, G. C.	Lt. Cmdr.
Brooklyn	Aloisio, Peter C.	Lt. Cmdr.
Brooklyn	Cardinale, Francis S.	
Brooklyn	Clorfeine, Irving	Lt. Cmdr.
Brooklyn	Cuttler, Sidney S.	Lieut.
Brooklyn	Ellman, Lee E.	Lieut.
Brooklyn	Follenius, A. J.	Lt. Cmdr.
Brooklyn	Fox, Morton	Lt. Cmdr.
Brooklyn	Goss, Kenneth J.	Lieut.
Brooklyn	Janis, Joseph J.	Lieut.
Brooklyn	Langan, Robert E. J.	Lieut.
Brooklyn	Mullen, George E.	Lieut.
Brooklyn	Schwartz, S. R.	Lieut.
Brooklyn	Simons, Samuel I.	Lieut.
Brooklyn	Walsh, Joseph D.	Lieut.
Brooklyn	Wells, Charles R.	Capt.
Buffalo	Flagg, Lloyd E.	Lieut.
Buffalo	Koepf, S. W.	Lt. Cmdr.

Cohoes	Amyot, Bruno E.	Lieut.
Freeport	Kronmann, Edwin C.	Capt.
Great Neck	Petrie, Francis J.	Cmdr.
Hempstead	Hrostoski, J. J.	Lt. Cmdr.
Mt. Vernon	Greenfield, Hyman	Lieut.
Mt. Vernon	Murphy, William J.	Lieut.
New York	Carey, Thomas I.	Lieut.
New York	Dunn, Robert L.	Lt. Cmdr.
New York	Gossel, John D.	Lt. Cmdr.
New York	Harris, W. D.	Lt. Cmdr.
New York	Leistner, Sidney	Lt. Cmdr.
New York	Pensak, S. G.	Lt. Cmdr.
New York	Rochford, T. E.	Cmdr.
New York	Salman, Irving	Lt. Cmdr.
New York	Wald, Samuel S.	Cmdr.
Pine Plains	Duxbury, John H.	Lt. Cmdr.
Plainfield	Mitthauer, J. R.	Lt. Cmdr.
Queens Village	Kraus, Frank R.	Lieut.
Rego Park	Weiss, Ernest E.	Lt. Cmdr.
St. Albans	Murray, W. M.	Lt. Cmdr.
Springfield Gard.	Draye, M. F.	Lt. Cmdr.
Syracuse	Greminger, Roger C.	Lieut.
Tuckahoe	Musante, C. J.	Lt. Cmdr.
Williston Park	Orgel, Jerome J.	
Yonkers	Mulford, F. S.	Lt. Cmdr.

North Carolina

Ahoskie	Powell, Jordan B.	Lt. Cmdr.
Gatesville	Lilley, Melvin M.	Lt. Cmdr.
Laurinburg	Biddell, F. H.	Lt. Cmdr.
Waynesville	Davis, Grover M.	Lt. Cmdr.

North Dakota

Fargo	Percy, Roe C.	Lieut.
Langdon	Rutten, Ruben J.	Lieut.
Wahpeton	Nelsen, Robert J.	Lt. Cmdr.

Ohio

Cambridge	MacConkey, W. R.	Lieut.
Carey	McKee, Everett V.	Lieut.
Chagrin Falls	Nichols, Donald H.	Cmdr.
Cleveland	Aufderheide, A. J.	Lt. Cmdr.
Cleveland	Suchy, T. D.	Lt. Cmdr.
Cleveland Hgts.	Friedman, Carl D.	Lieut.
Columbus	Benis, Joseph V.	Lieut.
Cuyahoga	Franke, W. H.	Lieut.
Greenville	Roesser, R. J.	Lt. Cmdr.
Jackson	Shumate, Dwight S.	Lieut.
Lakewood	Ennes, Ralph M.	Cmdr.
Londonville	Carpenter, S. K.	Lt. Cmdr.
Louisville	Jackson, James W.	Lieut.
Novelty	Johnson, R. E.	Lt. Cmdr.
Quaker City	Secrest, R. H.	Lt. Cmdr.
Sandusky	Stockdale, R. P.	Lt. Cmdr.
Toledo	Neill, Clive V.	Lt. Cmdr.
Warrensville	Abraham, Samuel	Lieut.
Youngstown	Jesik, Peter P.	Lieut.
Youngstown	Kerr, Harold E.	Cmdr.

Oklahoma

Blackwell	Austbo, Merritt C.	Cmdr.
McAlester	Rumsey, Dwight W.	Lieut.
Martha	Windes, K. W.	Cmdr.
Oklahoma City	Griffith, N. D.	Lt. Cmdr.
Oklahoma City	Matteson, D. W.	Lt. Cmdr.
Tulsa	Sims, Hugh A.	Lieut.
Tulsa	Trotter, L. C.	Lt. Cmdr.

Oregon

Astoria	Fosdal, Alfred	Lieut.
Independence	Herley, G. D.	Lt. Cmdr.
Portland	Hood, Donaldson	Lt. Cmdr.
Salem	Olinger, Harold M.	Lieut.

Pennsylvania

Barnesboro	Kerr, Harold B.	Lt. Cmdr.
Forty Fort	Davies, Carlton	Lt. Cmdr.
Girardville	Leahan, James T.	Lt. Cmdr.
Harrisburg	Miller, Charles R.	Lt. Cmdr.
Larksville	Warkomski, Clement H.	
Monongahela	Griffith, Wilmer P.	Lieut.
Nanticoke	Makowski, E. L.	Lt. Cmdr.
Norristown	Feder, Daniel	Lt. Cmdr.
Philadelphia	Jarvis, Edward C.	Lieut.
Philadelphia	Kneisel, Jules E.	Lt. Cmdr.
Philadelphia	Slack, Thomas S.	Lt. Cmdr.
Pittsburgh	Archibald, D. S.	Lt. Cmdr.
Pittsburgh	Elder, Herman K.	Cmdr.
Pittsburgh	Schechter, S. I.	Lieut.
Pittsburgh	Statti, Albert S.	Lieut.
Pittsburgh	Westervelt, Peter	Lt. Cmdr.
Pittsburgh	Wible, F. E.	Lt. Cmdr.
Punxsutawney	Jones, K. H.	Lt. Cmdr.
Schuylkill Haven	Detweiler, S. B.	Lieut.
Sharon Hill	Tomlinson, E. S.	Lt. Cmdr.
Upper Darby	Looby, John P.	Cmdr.
York	Stine, Gibson E.	Lieut.

Rhode Island

East Providence	Williams, Robert J.	Cmdr.
Middletown	McKay, Robert C.	Capt.
Riverside	Teeden, Russell C.	

South Dakota

Aberdeen	Hoeven, John H.	Lieut.
Flandreau	Benson, Bert E.	Lt. Cmdr.
Mitchell	Boyden, Carl H.	Lt. Cmdr.
Sioux Falls	Eggers, L. L.	Lt. Cmdr.

Tennessee

Cunningham	Batson, J. E.	Lt. Cmdr.
Greeneville	Mills, M. C. K.	Lt. Cmdr.
Knoxville	Coffey, George A.	Lieut.
Lewisburg	Bennett, Robert L.	Lieut.
Memphis	Bilsky, Isaac M.	Lieut.
Memphis	Cooper, Porter E.	Lieut.
Springfield	De Berry, R. J.	Lt. Cmdr.
Waynesboro	Yeiser, Robert J.	Lt. Cmdr.

Texas

Bellaire	Cunningham, W. P.	Lieut.
Cleburne	Curtis, James E.	Lieut.
Corsicana	Hollingsworth, J. I.	Lieut.
Dallas	Looney, Billy A.	Lieut.
Dallas	Nelson, James R.	Lt. Cmdr.
Ft. Worth	Cochran, Irad M.	Lieut.
Haskell	Vaughter, Jessee G.	Lieut.
Henderson	Wolfe, Edwin N.	Lieut.
Houston	Murphey, Marcus D.	Lieut.
Houston	Rosheger, V. P.	Lt. Cmdr.
Houston	Speer, Wayne H.	Lt. Cmdr.
Houston	Taylor, Thomas B.	Lieut.
Littlefield	Wood, Max G.	Lt. Cmdr.
Overton	Monaghan, R. P.	Lieut.
Pittsburg	Tryanham, W. B.	Lieut.
Seguin	Sagebiel, Ralph F.	Lieut.
Tyler	Nasits, B. J.	Lt. Cmdr.

Virginia

Alexandria	Powell, Hume S.	Lt. Cmdr.
Ashland	Weems, Julius B.	Lt. Cmdr.
Charlottesville	Hutcherson, I. L.	Lt. Cmdr.
Covington	George, George J.	Lieut.
Fairfax	Alexander, A. D.	Lt. Cmdr.
Formosa	Duffer, Aubrey C.	Lt. Cmdr.
Hampton	Burbank, John M.	Lt. Cmdr.
Millwood	Birch, Samuel M.	Lieut.
Norfolk	O'Keefe, John J.	Lieut.
Portsmouth	Buxton, S. E., Jr.	Cmdr.
Pulaski	Brockmeyer, M. W.	Lt. Cmdr.
Roanoke	Willson, P. M.	Lt. Cmdr.
Saint Paul	Davis, P. N., Jr.	Lieut.
Staunton	Armstrong, W. E.	Lt. Cmdr.
Staunton	Callar, Donald E.	Lt. Cmdr.
Warrenton	Davila, Jose R.	Lt. Cmdr.

Washington

Bremerton	Henderson, H. B.	Lieut.
Lynden	Fisher, W. A.	Lt. Cmdr.
Renton	Shuler, Elmer C.	Lt. Cmdr.
Seattle	Jenkins, Ralph P.	Lt. Cmdr.
Snohomish	Odegard, H. E.	Lt. Cmdr.

West Virginia

Bluefield	McCue, James D.	Lt. Cmdr.
Charleston	Sines, Francis A.	Lt. Cmdr.
Fairmont	Sowers, Scott	Lieut.
Keyser	Eagle, James W.	Lt. Cmdr.
Logan	Curry, Roy C.	Lt. Cmdr.
Weston	Wojcihovski, L. J.	Lt. Cmdr.
Wheeling	Armbrecht, E. C.	Lt. Cmdr.

Wisconsin

Antigo	Stewart, Donald A.	Lieut.
Beloit	Larson, Mark S.	Lieut.
Kenosha	Clark, Wayne J.	Lt. Cmdr.
Lancaster	Becker, Reginald J.	Lieut.
Madison	Hoffman, H. J.	Lt. Cmdr.
Milwaukee	Bittman, Walter J.	Lieut.
Milwaukee	Bull, Francis A.	Lt. Cmdr.
Milwaukee	Harder, Milford E.	Lieut.
Princeton	Priske, Lester J.	Lieut.
Rhinelander	Metternich, J. C.	Lieut.
Watertown	Craine, Donald R.	Lieut.

NEWS OF DENTISTRY

Trustees Name Miami for 1946 Meeting of House of Delegates

Miami, Fla., has been selected as the 1946 meeting place for the House of Delegates of the American Dental Association and, if present plans are completed, the session will take place some time in October. This decision was made by the Board of Trustees which met in Chicago, February 8-11. The impossibility of procuring convention facilities for a full scientific meeting of the Association in 1946 was responsible for the decision of the Board. The Board also appointed a special committee to develop plans for a full-scale scientific meeting in 1947.

A full report of the Board's transactions will appear in a later issue.

Thirteen Thousand Register at Chicago Midwinter Meeting

Thirteen thousand persons were registered at the Chicago Dental Society's annual Midwinter Meeting, which concluded its four-day session on February 14. Registered during the meeting were 4,132 members of the American Dental Association from outside Chicago and 2,557 members from the Chicago area. In addition, there were registered 42 physicians, 26 nurses, 455 students, 1,043 dental assistants, 140 dental hygienists, 180 lay guests, 1,658 family members, 731 laboratory personnel, 1,207 exhibitors' representatives and 767 exhibitors' guests.

Journal Subscriptions Stop Unless 1946 Dues Are Paid

Subscriptions to THE JOURNAL are automatically terminated with this issue unless dues for 1946 have been paid.

A.D.A. Journal Index for 1945 Available in March

THE JOURNAL Index for Volume 32, 1945, will be available upon request on or about March 7.

Members of the Association are urged to send in their requests promptly to the American Dental Association, 222 East Superior St., Chicago 11, Ill.

War Department Announces Reduction of Army Discharge Points

The War Department announced recently that all enlisted men with 45 points or 30 months of service will be released or will be aboard ship returning home by April 30. According to the report, all enlisted men with 40 points or 24 months of service will be released or will be aboard ship returning home by June 30.

Refresher Course in Children's Dentistry Offered

A postgraduate refresher course in children's dentistry will be offered by the College of Physicians and Surgeons, School of Dentistry, San Francisco, April 1-6.

Lectures and demonstrations will be given on the following subjects: child management; anesthesia and extraction; cavity preparation, fitting of matrix, placement of filling; exposed pulps in primary teeth and treatment of non-vital primary teeth; tooth guidance; caries control; public health; economic aspects of dental caries; pediatrics in dentistry for children; anatomy and morphology of primary teeth; oral pathology; fractured anterior permanent teeth.

Pictured above is Col. Roy A. Green, a past-president of the California State Dental Association and veteran of two world wars.

Colonel Roy A. Green to Return to Private Practice

After more than five years of active service as a combat infantry commander, Col. Roy A. Green, a past-president of the California State Dental Association (1930-1931), will return to the private practice of dentistry in Sacramento, Calif., on March 15.

Colonel Green took part in some of the most difficult actions in the Pacific war and has been awarded what is probably one of the longest lists of combat decorations to be given a dentist in World War II.

He commanded the 1st Battalion of the 184th Infantry when that outfit landed on Kiska on August 14, 1943. Six months later, he led his troops in an assault landing on Kwajalein Island.

In October 1944, he participated in the assault on Leyte and during the battle he was promoted to regimental commander. After the Leyte campaign, he led the 184th Infantry Regiment in an assault landing on Okinawa on April 1, 1945. As the ranking officer in his sector of that Japanese island, he received the surrender of 60,000 Japanese troops from Lieutenant General Layama on September 27, more than a month after V-J Day.

Decorations he has received include the Silver Star Medal, the Bronze Star Medal, two Oak Leaf Clusters to the Bronze Star and the Combat Infantry Badge.

Colonel Green, a graduate of the University of California (1919), served as an infantryman in World War I. He was president of his local society in 1926-1927 and was state representative of the two California State Dental Associations from 1931 until he reentered the Army in December 1940.

1946 Fund Campaign of the American Red Cross Inaugurated

The American Red Cross will strive for its national goal of $100,000,000 during the month of March, C. Del Pendergrast, chairman of the House Organs Committee, has announced. Special emphasis is placed on the continued need for Red Cross services to occupation forces, hospitalized servicemen, veterans and their families. This need, it is stated, has been heightened rather than diminished since the war's end.

According to Martin H. Kennelly, general chairman of the campaign, the organization faces an expanding peacetime program more widespread in scope than in years prior to World War II. Expanded programs of instruction in many subjects are being launched.

"Expenditures for 1946 actually will exceed the national Campaign goal of $100,000,000, although Red Cross budget estimates are pared to the minimum," said Kennelly.

American Dental Association's Roster of Members Available March 1

The American Dental Association's 1945 Roster of Members will be available to all members of the Association on or about March 1. The first publication of its kind, the Roster of Members will contain names and addresses of more than 55,000 members.

Copies can be obtained by writing the American Dental Association, 222 East Superior St., Chicago 11, Ill.

National Society for Crippled Children to Conduct Campaign March 21-April 21

The year 1946 marks the Silver Anniversary as well as the thirteenth annual sale of Easter Seals of the National Society for Crippled Children and Adults. The Easter Seal campaign will be conducted March 21 through April 21.

The number of persons needing the special services offered by the society include over one-third million crippled children registered in the states; almost seven million adults crippled from disease or accident, with one hundred thousand added annually; and, from World War II, over fourteen thousand veteran amputees.

Rear Admiral Lyle Named Senior Member of Public Law 284 Board

According to a recent announcement from the Bureau of Medicine and Surgery, Navy Department, Rear Adm. Alexander G. Lyle, Dental Corps, U. S. Navy, has been named senior member of a special board formed to put into effect Public Law 284, which authorizes reorganization of the dental service.

Other members are Capt. Alfred W. Chandler, Capt. Clemens V. Rault, Capt. Francis G. Ulen, Capt. Henry H. Delaney, Cmdr. John H. Paul, all of the U. S. Navy Dental Corps, and also Cmdr. Francis W. Laurent, U. S. Navy, Retired. Commander Paul will act as recorder.

The board will deliberate upon any new regulations, directives, orders and changes in existing Bureau manuals or U. S. Navy Regulations and will recommend to the Secretary of the Navy any changes necessary to effectuate the provisions of Public Law 284.

Mail Order Denture Firm Files Suit to Regain Use of Mails

Two Chicago women, described as doing business as the United States Dental Company, filed suit January 29, in Washington, D. C., District Court, against Postmaster General Robert E. Hannegan and other officials seeking to enjoin them from denying the plaintiffs' use of the mails for sending packages.

The suit charges that the Postmaster General ordered Margaret M. Johnson and Mary E. Layton to cease carrying on their business through the mail. The authority for the order was based on the Federal Denture Act of 1942 forbidding a person who is not licensed to practice dentistry to mail dentures from casts made from teeth.

The complaint claims that under the order the dental company is denied mailing of all packages. It also asks the court to find the Denture Act unconstitutional.

Justice Alexander Holtzoff issued a temporary order restraining the Post Office Department from refusing to accept packages. The suit seeks to have a three-judge tribunal set up to hear the complaint. A three-judge tribunal is required to consider the constitutionality of an act.

The Committee on Legislation reports that the U. S. Circuit Court of Appeals has already upheld the constitutionality of the Federal Denture Law, and that the U. S. Supreme Court refused to review the case. It would seem, therefore, that the constitutionality of the law is no longer open to question.

CURRENT LITERATURE

Procaine Toxicity with Report of a Near Fatal Case. George F. Hewson. Milit. Surgeon 97:489, December 1945.

A 23-year-old first-class fireman in the U. S. Navy suffered a severe reaction following the careful injection at the stellate ganglion of approximately 0.1 gm. of procaine in 1 per cent solution without epinephrine. The patient had received injections of procaine on four previous occasions without reported ill effects. However, the severe reaction suffered by the patient following the injection of procaine in the instance reported was rather clearly attributable to the procaine.

Ten minutes after the injection, the patient had generalized convulsions and became unconscious; his breathing ceased and his pulse disappeared. He appeared to be dead. Epinephrine was injected into the left ventricle of the heart and artificial respiration was given. After a minute, the patient began to breathe again and the pulse returned feebly. Thirty-five minutes after the procaine injection, the patient began having violent convulsions.

A wide variety of medication was used in an effort to relieve the patient, but "three and one-half hours following the procaine injection, tonic and clonic contractions of the arms and legs were so severe that it was difficult to keep the patient on the table."

Eight and one-quarter hours after the procaine injection, the patient was too restless to permit the free administration of fluids parenterally. Treatment was continued and the patient was almost normal five days later and was discharged to full duty fifteen days after the procaine injection.

The author states: "Allergy did not seem to be a factor in this case as patient received procaine on four previous occasions without having symptoms. He has no history of allergy and the skin wheal showed no sensitivity reaction. . . . The only conclusion we can draw is that procaine proved to be toxic when given in a normal amount to this particular patient at that particular time."—*Donald A. Wallace.*

Experimental Studies in Calcification. I. Effect of a Rachitogenic Diet on Dental Tissues of White Rat. J. P. Weinmann and Isaac Schour. Am. J. Path. 21:821, 1945.

Thirty-three white rats were placed on a rachitogenic diet for a period of from one to fifty-six days after weaning (at 21 days) and the upper incisors and molars were examined histologically for evidence of pathologic changes. In addition, a study was made of twenty-five litter-mates, 21 to 77 days of age, that were fed a normal control diet. The disturbances of the calcified dental tissues in experimental rickets were confined to the dentin and cementum, the enamel resisting the accompanying metabolic disturbances. The histologic findings were as follows: 1. Enamel formation and calcification were normal, with no evidence of hypoplasia. The enamel organ showed cystic degeneration in the incisal half of the incisor in approximately 50 per cent of the animals that had been on the experimental diet for four weeks. 2. Dentin formation was retarded, while calcification was both retarded and disturbed. The newly formed dentin had an interglobular texture. The enamel-covered dentin was more affected than the cementum-covered dentin. 3. Cementum formation was normal in rate, but calcification was defective. Shallow areas of resorption on the molar roots were more frequent in the experimental than in the control animals.—*R. P. Likins.*

Role of Unsaturated Fatty Acids in Changes of Adipose and Dental Tissues in Vitamin E Deficiency. Henrik Dam and Humberto Granados. Science 102: 327, 1945.

Rats fed from birth a vitamin E-deficient diet containing the fatty acids from 20 per cent cod liver oil exhibited considerable peroxidation and marked brown discoloration of the adipose tissue. The deposition of the normal yellow-brown pigment of the incisor teeth was inhibited in these animals. Rats fed the same basal diet, but given instead of fatty acids the nonsaponifiable fraction from 20 per cent cod liver oil, failed to show such changes. Three different fatty acid fractions of cod liver oil were compared in the second part of the experiment. Low, middle and highly unsaturated fractions were fed to three groups of rats also from birth. Only the animals fed the highly unsaturated fraction exhibited marked peroxidation and discoloration of the adipose tissue, comparable with the changes observed in the animals fed the total fatty acid fraction. The deposition of the normal incisor pigment in the maxillary incisors of these animals was at first retarded and then completely checked. In the mandibular incisors, complete depigmentation failed to occur within the ranges of the experimental period. A study of the chemical nature of this normal enamel pigment showed inorganic iron in the ferric form, which alone accounts for the total color of the pigment. This pigment apears to be embedded in or loosely combined with an organic matrix. Depigmented enamel from teeth of vitamin E-deficient rats failed to give positive reactions for iron.—*Humberto Granados.*

Study of Ascorbic Acid Nutrition. H. Jean Leeson *et al.* Canad. M. A. J. 53:341, October 1945.

One hundred and twenty-nine patients in a mental hospital were studied over a three-month period. All of the subjects had been in the institution for at least several years and were receiving a uniform diet containing about 25 mg. of ascorbic acid daily. During the three-month period, one group of the 129 patients was maintained on the 25 mg. of ascorbic acid daily; a second group was given a supplement of 58 mg. of ascorbic acid in the form of 8 ounces of canned grapefruit juice, bringing the total daily intake of ascorbic acid to 85 mg., while a third group was given 100 mg. of synthetic ascorbic acid in addition to the 25 mg. received in the diet, the total intake being 125 mg.

Examination of the gingivae and determinations of plasma ascorbic acid and hemoglobin were made at the beginning and at the end of the period. Plasma ascorbic acid levels were also determined six weeks after the beginning of the study. A significant rise in plasma ascorbic acid occurred in the supplemented groups, the maximum being attained within six weeks after supplementation began. The maximum was significantly higher in the subjects receiving 125 mg. daily than in the 85 mg. group.

Hemoglobin levels were significantly higher in men than in women. No rise in hemoglobin levels occurred in the supplemented groups. Gingivitis was prevalent in all subjects. No significant improvement occurred in the supplemented groups in the three-month period. In no way did the physical findings on reexamination suggest any improvement in those subjects who received supplements of ascorbic acid above their usual intake of about 25 mg. a day.—*S. W. Leung.*

The Effect of Topically Applied Sodium Fluoride on Dental Caries Experience. II. Report of Findings for Second Study Year. J. W. Knutson and W. D. Armstrong. Pub. Health Rep. 60:1085, September 1945.

According to the data on the incidence of dental caries in the permanent teeth of a treated group of children for the second year of a longitudinal study, the children in the treated group, during an eight-week period, received seven to fifteen topical applications of a 2 per cent sodium fluoride

solution to the teeth in the left quadrants of the mouth. During the two-year period, the number of treated teeth of the treated group to become carious was 41.3 per cent less than that of the untreated teeth of the same group. The number of additional tooth surfaces that became decayed in teeth which were carious at the beginning of the study was 23.1 per cent less in treated than in untreated carious teeth. During the second study year, 46.6 per cent less treated teeth became carious than untreated teeth. The number of additional surfaces that became decayed in previously carious teeth was 25.2 per cent less in treated than in untreated carious teeth. The findings generally confirm those reported for the first study year. In addition, it is indicated that the fluoride treatments are fully as effective in inhibiting dental caries during the second year following treatment as during the first year. Further, the evidence suggests that the treatment of carious teeth reduces by approximately 20 per cent the liability to attack on additional surfaces. The incidence of caries in the permanent teeth of the control group of children, by mouth quadrants, was strikingly similar in the two upper quadrants and also in the two lower mouth quadrants.—*J. E. Gilda.*

Experimental Studies in Calcification. II. Effect of Rachitogenic Diet on Alveolar Bone of White Rat. J. P. Weinmann and Isaac Schour. Am. J. Path. 21:821, 1945.

The jaws were dissected and portions bearing the upper incisors and molars were prepared for decalcified histologic sections. Findings that the balanced interaction of bone apposition and resorption is disrupted are indicated by well-delineated pathologic changes. New bone, although its formation seems to proceed at a normal rate, remains uncalcified and persists as osteoid tissue. As the latter fails to undergo resorption, excessive accumulation of osteoid tissue results. Sites normally showing apposition continue to do so, while those sites normally showing resorption are inactive. Distortion of the normal growth pattern of the alveolar bone is manifest as a result of subsequent imbalance between apposition and resorption. Another consequence of failure of resorption of osteoid tissue is localized reduction of the periodontal tissue. Hyaline degeneration of the connective tissue and complete obliteration of the periodontal membrane in some cases follow.—*R. P. Likins.*

Influence on the Rat Incisor of Vitamin K Deficiency in the Presence of Sulfadiazine Containing Diets. Humberto Granados and Henrik Dam. J. D. Res. 24: 137, 1945.

Three groups of rats, reared for a period of ninety-one days, were fed the following diets: group I, K-deficient, 1 per cent sulfadiazine; group II, K-sufficient, 1 per cent sulfadiazine; group III (normal control), dog chow. No significant differences were observed between animals on sulfadiazine-containing diets (groups I and II) in growth, enamel pigmentation and rates of eruption and attrition of incisors. In these groups there was a striking deficiency of growth, accompanied by severe symptoms of intoxication, and a marked decline of eruption and attrition rates of incisors, as compared with group III. The known blood changes in vitamin K deficiency were definitely observed in group I, but the lack of dental differences between K-deficient (group I) and K-sufficient (group II) animals indicates that vitamin K itself does not influence enamel pigmentation or eruption and attrition of incisor teeth. Observed differences between animals fed sulfadiazine (groups I and II) and those sulfadiazine-free (group III) signify that the administration of sulfadiazine to prevent vitamin K formation in the intestine causes severe intoxication and retardation of growth reflected in lowering of eruption and attrition rates of the incisor teeth.—*Humberto Granados.*

Dentistry in the Ghetto. H. Salamon. Bull. Hist. Med. 18:66, June 1945.

The legacy of knowledge relating to the

oral structures which the ancient Jews possessed is presented under anatomy, physiology, pathology, therapeutics and surgery. In numerous quotations from the two major sources, the Bible and the Talmud, there is no direct mention of a carious tooth. Extractions appear to have been particularly dreaded. Restoration, for cosmetic purposes, of lost natural front teeth only, was widespread in biblical times. As no evidence of specialization within the healing profesison can be found, it may be assumed that the physician treated diseases of the mouth and teeth. Certain craftsmen prepared the prostheses.

In the ghetto of the middle ages, a group that could be clearly identified as dentists developed. These individuals, of all the specialists, were held in lowest esteem, being ranked with the itinerant quacks of the markets. Progress is apparent in only two fields: operative dentistry and, to a greater extent, prosthetic dentistry. Prosthetic devices, which were still considered as adornments, were wedged in position between sound teeth or bound in place by gold suture wires. In some cases, holes were bored (labiolingually) through the crowns of adjacent teeth and gold sutures secured through these. This practice was first begun in the sixteenth century. The remarkable gold shell crown, which was known from ancient times, was widely applied by Jewish goldsmiths. Filling of teeth for therapeutic reasons seems to have also been practiced. Details regarding procedures, materials and instruments are unknown.—*J. E. Gilda.*

Experimental Studies in Calcification. III. Effect of Parathyroid Hormone on Alveolar Bone and Teeth of Normal and Rachitic Rat. J. P. Weinmann and Isaac Schour. Am. J. Path. 21:821, 1945.

The effect of single and multiple injections of parathyroid hormone on the upper jaws of white rats was studied histologically in twenty-three animals fed a normal diet and thirty-eight animals placed on a rachitogenic diet after weaning. Sixteen normal and seventeen rachitic rats from 42 to 77 days of age were used as controls. Injections of 50 Hanson units increased osteoblastic activity and new formation of alveolar bone, whereas injections of 100 or more Hanson units resulted in progressive osteoclasis and fibrous replacement of bone. The reaction of the bone to parathyroid hormone was essentially the same in normal and in rachitic rats, except for the fact that the osteoid tissue in the latter was more resistant to resorption. After injection of large doses, the alveolar bone of the molar areas showed more severe changes than that of the incisor region. Enamel, dentin and cementum were found resistant to resorption under parathyroid hormone treatment.—*R. P. Likins.*

Oral Manifestations of Certain Systemic Disorders. M. Heinemann and B. G. Anderson. Yale J. Biol. & Med. 17: 583, 1945.

In ten cases of lesions of the oral mucous membrane or gingiva related to endocrine or allergic states, the appearance of the oral lesions varied widely, three distinct types being found: (1) pyorrhea alveolaris, (2) Vincent's ulcers and (3) aphthous lesions. In one of two female patients having pyorrhea alveolaris which showed exacerbation during menstruation, marked improvement followed administration of the estrogenic hormone. Previous local therapy had been ineffective. No improvement could be observed in the other patient. Vincent's ulcers that stubbornly resisted local treatment in two patients and showed exacerbations during menstruation responded favorably to treatment with progesterone. Aphthae, or "canker-sores," associated with menstruation failed to reappear under treatment with estrogenic substances. Aphthae could be attributed to food allergy in three observations on men. These observations suggest a variety of causes for lesions which could not be differentiated morphologically. Combination of allergic, endocrine, degenerative and bacterial changes may cause lesions. In a given case, it may be difficult or impossible to determine which of these factors is dominant, contributory or possibly unrelated.—*J. E. Gilda.*

DEATHS

Goodman, Nye White, Los Angeles, Calif.; died June 26, 1945, following a long illness. Dr. Goodman was a founder and past-president of the American Academy of Restorative Dentistry, Fellow of the American College of Dentists, honorary member of the American Dental Assistants Association and life member of the Southern California State Dental Association. Dr. Goodman was an outstanding essayist and clinician and had appeared before the American Dental Society of Europe as well as before almost all of the state dental societies.

Dr. Goodman was one of the notably skilful members of the dental profession, and his contributions to the technics and literature have enriched the profession.—*John Egbert Nyman.*

Adles, Benjamin, New York, N. Y.; School of Dental and Oral Surgery, Columbia University; died December 23; aged 50.

Bailey, C. K., Grenada, Miss.; School of Dentistry, University of Louisville; died January 1.

Bain, Neil M., Portland, Ore.; School of Dentistry, University of Minnesota; North Pacific Dental College; died November 21; aged 56.

Baker, Harry Q., Kansas City, Mo.; School of Dentistry, University of Kansas City; died December 2; aged 49.

Baron, William F., Bronx, N. Y.; died December 26.

Barons, Frank S., Rochester, N. Y.; School of Dentistry, University of Buffalo; died November 22; aged 70.

Bellchamber, Charles E., Effingham, Ill.; School of Dentistry, Washington University, 1898; died December 3; aged 69.

Bliven, Frank C., New York, N. Y.; died December 27; aged 95.

Bonney, Thomas C., Aberdeen, S. Dak.; College of Dentistry, University of Illinois; died November 23.

Bronson, Archibald F., Mason City, Iowa; Dental School, Northwestern University; died January 2; aged 71.

Brooks, Lorenzo, Atlanta, Iowa; College of Dentistry, State University of Iowa; died in January; aged 52.

Brown, Carl S., Hutchinson, Mo.; died in December; aged 69.

Bugden, Frank E., New Rochelle, N. Y.; College of Dentistry, New York University, 1909; died December 24; aged 58.

Bush, William N., High Point, N. C.; died January 6.

Cherault, E. J., Houston, Texas; School of Dentistry, Tulane University; died January 7; aged 64.

Clemmer, Howard S., Spokane, Wash.; died January 4.

Cochran, Thomas B., Alexandria, Va.; School of Dental and Oral Surgery, Columbia University; died December 16; aged 71.

Cohen, Jacob, Haverhill, Mass.; Tufts College Dental School; died October 4; aged 50.

Corey, M., Chicago, Ill.; Chicago College of Dental Surgery; died December 25; aged 45.

Corrigan, Maurice D., Sandy Hook, Conn.; Baltimore College of Dental Surgery, University of Maryland; died December 28; aged 48.

Coulson, Nathaniel, San Francisco, Calif.; College of Dentistry, University of California; died December 18; aged 92.

Crosby, Lewis W., Washington, D. C.; Baltimore College of Dental Surgery, University of Maryland; died November 23; aged 67.

Cunningham, Cecil C., Arlington, Mass.; died November 14; aged 65.

Dana, Amos W., Burlington, Iowa; Chicago College of Dental Surgery; died December 31; aged 75.

Day, Harry N., Milford, Mass.; died October 16; aged 89.

Dilworth, George, Red Lodge, Mont.; died December 18; aged 77.

Dinger, Carl, Phillipsburg, Pa.; Baltimore College of Dental Surgery, University of Maryland; died December 23; aged 68.

Dorival, John H., Los Angeles, Calif.; died November 30; aged 80.

Dorward, James O., Tulsa, Okla.; School of Dentistry, University of Michigan; died January 11; aged 88.

Dunne, Charles M., Daytona Beach, Fla.; Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania; died December 22; aged 68.

Ennis, Edward M., Medford, Mass.; died December 28; aged 76.

Fleischer, Christian C., Sioux Falls, S. Dak.; Chicago College of Dental Surgery; died January 10; aged 70.

Fry, B. William T., Milan, Ill.; Dental School, Northwestern University, 1911; died January 3; aged 56.

George, Richard E., Detroit, Mich.; School of Dentistry, University of Michigan; died December 11; aged 50.

Gordon, Jeremiah D., Cincinnati, Ohio; College of Dentistry, Ohio State University; died December 28; aged 86.

Grant, Donald S., Walton, N. Y.; Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania; died November 26; aged 44.

Greenhood, Charlotte, San Francisco, Calif.; died January 7; aged 48.

Gross, Louis; died in January; aged 29.

Guariho, Louis C., Niagara Falls, N. Y.; School of Dentistry, University of Buffalo; died December 22; aged 49.

Hadfield, Harry C., Beloit, Wis.; Dental School, Northwestern University; died December 17.

Hall, Clarence V., Indianapolis, Ind.; Ohio College of Dental Surgery, Dental Department, University of Cincinnati; died January 1; aged 70.

Hall, Eugene, Columbus, Ohio; died December 23; aged 69.

Hamel, John H., Syracuse, N. Y.; School of Dentistry, University of Buffalo, 1911; died December 12.

Hamilton, S. B., Knoxville, Tenn.; College of Dentistry, University of Tennessee, 1910; died January 9; aged 58.

Hancock, D. H., McKinney, Texas; died October 2; aged 88.

Heazelton, Frank, Camden, N. J.; Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania, 1888; died December 23; aged 80.

Hert, Benedict S., Rochester, N. Y.; Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania; died December 25; aged 83.

Hipwell, Abraham L., Los Angeles, Calif.; died December 29.

Hoehl, Henry P., Milwaukee, Wis.; Dental Department, Milwaukee Medical College; died December 22; aged 73.

Hollenback, Hudson S., Mount Carmel, Pa.; Pennsylvania College of Dental Surgery; died November 30.

Holmes, Arthur B., Guilford, Conn.; died January 2; aged 62.

Jewett, H. R., Clarkston, Ga.; died January 5; aged 61.

Johnson, A. F., Arlington, Minn.; College of Dentistry, University of Minnesota, 1920; died October 12.

Jones, J. Clarence, Portland, Ore.; Dental School, Northwestern University, 1900; died December 14.

Kalb, George E., Columbus, Ohio; College of Dentistry, Ohio State University; died December 15; aged 69.

Koltes, John I., Milwaukee, Wis.; Dental School, Marquette University; died December 10; aged 57.

Lane, J. B., Bishopville, S. C.; Dental Department, University College of Medicine, Richmond, Va.; died December 22.

Lazerick, Morris J., Cleveland, Ohio; School of Dentistry, Western Reserve University; died December 30; aged 51.

Ledbetter, M. A., Henderson, Texas; died December 5.

Lee, William H., Kettle Falls, Wash.; died November 26.

Lenort, John D., Lawton, Ky.; Dental School, Northwestern University; died December 5; aged 81.

Liles, Curtis O., Sylacauga, Ala.; died December 23.

Logan, Edmund G., Los Angeles, Calif.; died December 13; aged 88.

Luton, Leonides I., Detroit, Mich.; died December 24; aged 66.

Lynch, T. A., Los Angeles, Calif.; Chicago College of Dental Surgery, Loyola University, 1902; died in November.

McCooey, Clark J., Chicago, Ill.; Chicago College of Dental Surgery, Loyola University, 1936; died February 2; aged 33.

McKinley, Elmer E., Mustang Prairie, Texas; died January 10; aged 61.

McLeod, E. A., Central City, Iowa; College of Dentistry, State University of Iowa; died December 25; aged 60.

McMullen, H. C., Cambridge, Ill.; College of Dentistry, University of Illinois; Chicago College of Dental Surgery, Loyola University; died December 20; aged 70.

Marcy, Albert M., Clarksburg, Ohio; Baltimore College of Dental Surgery, University of Maryland; John Hopkins Medical School; died January 7; aged 73.

Mauss, Charles W., Chelsea, Mass.; Tufts College Dental School, 1915; died December 18; aged 52.

Meek, Charles A., Berkeley, Calif.; College of Dentistry, University of California, 1891; died in November; aged 75.

Miller, Romain W., Berwick, Pa.; School of Dentistry, Temple University; died December 5; aged 55.

Obert, John T., Los Angeles, Calif.; School of Dentistry, Washington University, 1914; died December 8; aged 54.

Oser, Walter, New Orleans, La.; died in September.

Paine, Romeyn M., Pasadena, Calif.; died November 19.

Pangburn, S. A., Northwood, Iowa; Chicago College of Dental Surgery, Loyola University, 1901; died November 30; aged 70.

Pankow, Walter Lee, Sioux Falls, S. Dak.; School of Dentistry, University of Louisville; died in December; aged 58.

Parrott, Howard, Cincinnati, Ohio; Ohio College of Dental Surgery, Dental Department of the University of Cincinnati; died November 14; aged 77.

Patten, Walter P., Lakeland, Ga.; School of Dentistry, Atlanta-Southern Dental College, Emory University; died December 13; aged 65.

Patterson, J. P., Galion, Ohio; died January 1.

Payne, Charles, Oxford, N. Y.; School of Dentistry, University of Buffalo, 1897; died November 14; aged 82.

Pearson, Arthur L., Lockport, N. Y.; College of Dentistry, New York University; died November 6; aged 74.

Pearson, H. L., Clarksville, Texas; Baltimore College of Dental Surgery, University of Maryland; died October 1; aged 87.

Pedersen, George N., Gresham, Ill.; died December 25; aged 58.

Perkins, Elmer A., Houston, Texas; School of Dentistry, Indiana University, 1902; died December 12; aged 70.

Peterson, Mahlon O., Jeffers, Minn.; Chicago College of Dental Surgery, Loyola University, 1924; died in December; aged 42.

Phillips, Herbert, Baltimore, Md.; Baltimore College of Dental Surgery, University of Maryland; died November 23.

Pickering, Sylvester F. A., New Hampshire, Maine; died November 1; aged 78.

Polensky, John, Wingdale, N. Y.; Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania; died November 10; aged 53.

Porter, Ross, Oil City, Pa.; School of Dentistry, University of Michigan; died December 18; aged 74.

Provencher, N. O., Lowell, Mass.; died November 30; aged 66.

Pullman, Peter, Washington, D. C.; died December 4; aged 45.

Randolph, R. N., Los Angeles, Calif.; died November 14; aged 58.

Rea, Floyd G., Brooklyn, N. Y.; died October 7.

Redner, Charles F., Utica, N. Y.; School of Dentistry, University of Buffalo; died in January.

Reed, Augusta E., Holyoke, Mass.; died January 7; aged 88.

Richter, Samuel, Miami, Fla.; died December 31; aged 73.

Robaskiewicz, Charles, Plymouth, Pa.; died November 27; aged 60.

Robinson, Edwin S., New York, N. Y.;

College of Dentistry, New York University; died December 7; aged 80.

Rodenhouser, Henry C., Peoria, Ill.; Dental School, Northwestern University; died December 27; aged 70.

Rogers, Thomas L., Berkeley, Calif.; College of Dentistry, University of California, 1891; died January 11; aged 67.

Roman, Benjamin A., Wilmette, Ill.; died December 4; aged 54.

Rose, Joseph E., Iowa City, Iowa; College of Dentistry, State University of Iowa; died November 21; aged 74.

Rossing, Anna, Mason City, Iowa; died December 28.

Roth, Albert C., Aurora, Ill.; died November 19; aged 59.

Ryan, James E., Houston, Mass.; Baltimore College of Dental Surgery, University of Maryland; died December 7; aged 42.

Sageman, Lewis W., Mount Vernon, N. Y.; College of Dentistry, New York University, 1881; died November 4; aged 86.

Scannell, John B., Providence, R. I.; Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania; died November 17.

Schuler, Arthur E., Elkhart, Ind.; Dental School, Northwestern University; died December 29; aged 69.

Schultz, Paul, Elysian, Minn.; Dental School, Northwestern University; died December 19; aged 49.

Seaver, George H., Watertown, N. Y.; died October 28; aged 84.

Shallen, Israel M., Woonsocket, R. I.; Tufts College Dental School; died January 3; aged 58.

Shelton, John D., Joplin, Mo.; School of Dentistry, Washington University, 1906; died November 21; aged 77.

Shields, H. D., South Bend, Ind.; Chicago College of Dental Surgery, Loyola University; died June 20.

Simmonds, Richard S., Westwood, Ohio; College of Dentistry, Ohio State University, 1939; died December 24; aged 32.

Simonetti, Ernest J., Brooklyn, N. Y.; Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania, 1918; died in 1945.

Sims, Thomas A., Fayetteville, Ark.; died October 24; aged 87.

Siwinski, Walter, Baltimore, Md.; Baltimore College of Dental Surgery, University of Maryland, 1906; died November 3; aged 62.

Smith, Albert H., Philadelphia, Pa.; died January 4; aged 76.

Smith, D. N., Boise, Idaho; died December 12; aged 89.

Smith, Fred T., San Anselmo, Calif.; died November 12; aged 60.

Smith, George W., Painesville, Ohio; School of Dentistry, Western Reserve University, 1905; died December 4; aged 66.

Smith, Harry A., Middletown, Ohio; died October 30; aged 71.

Smith, Worth O., Tunkhannock, Pa.; Baltimore College of Dental Surgery, University of Maryland; died October 20; aged 67.

Sohl, Orrin, Keokuk, Iowa; Keokuk Dental College, Dental Department of Keokuk Medical College, 1905; died December 8; aged 64.

Sommermeyer, Edward F., St. Paul, Minn.; died December 27; aged 70.

Sparks, Frank M., Rushville, Ind.; Ohio College of Dental Surgery, Dental Department of the University of Cincinnati, 1891; died November 1; aged 76.

Sparks, Hugh H., Louisa, Ky.; School of Dentistry, University of Louisville; died January 12; aged 53.

Speer, C. E., Hillsdale, Mich.; died January 11; aged 86.

Spurbeck, Lee E., Eveleth, Minn.; School of Dentistry, University of Minnesota; died November 6; aged 59.

Stagg, Leonard W., Schuylkill Haven, Pa.; Thomas W. Evans Museum and Dental Institute School of Dentistry, University of Pennsylvania; died November 7.

Starr, Robert Walter, Jr., Cape May, N. J.; died in 1945.

Stolpher, Isaac, Brooklyn, N. Y.; College of Dentistry, New York University, 1917; died October 7; aged 65.

Stone, Clarence K., Ossining, N. Y.; died December 12; aged 84.

Streetman, Willard, Cameron, Texas; College of Dentistry, University of Tennessee; died November 9.

Sturdevant, Ralph S., Exeter, Nebr.; College of Dentistry, University of Nebraska, 1912; died November 29; aged 55.

Swain, Homer, Chico, Calif.; College of Dentistry, University of California, 1905; died in November.

MEETINGS AND ANNOUNCEMENTS

Meetings of State Societies

Alabama Dental Association, Birmingham, Thomas Jefferson Hotel, April 9-11. Angus M. Sellers, 812 Empire Bldg., Birmingham, Secretary.

Connecticut State Dental Association, Hartford, Hotel Bond, June 5-7. E. S. Arnold, 37 Linnard Road, West Hartford 7, Secretary.

Dental Society of the State of New York, New York City, May 13-16. Charles A. Wilkie, 1 Hanson Pl., Brooklyn, Secretary.

Georgia Dental Association, Atlanta, Ansley Hotel, May 12-15. R. H. Murphy, 605 Bankers Insurance Bldg., Macon, Secretary.

Iowa State Dental Society, Des Moines, Hotel Fort Des Moines, May 6-8. A. N. Humiston, 417 Higley Bldg., Cedar Rapids.

Kentucky State Dental Association, Louisville, Brown Hotel, April 1-3. J. L. Walker, 640 Barbee Way South, Louisville 8, Secretary.

Louisiana State Dental Society, Baton Rouge, April 4-6. Julian S. Bernhard, 407 Medical Arts Bldg., Shreveport 45, Secretary.

Maine Dental Society, Portland, Eastland Hotel, June 27-29. Alonzo H. Garcelon, Augusta, Secretary.

Massachusetts State Dental Society, Boston, Hotel Statler, May 6-9. Philip E. Adams, 106 Marlborough St., Boston, Secretary.

Michigan State Dental Society, Detroit, April 15-17. H. C. Gerber, Jr., 1514 Olds Tower Bldg., Detroit, Executive Secretary.

Mississippi Dental Association, Jackson, May 26-29. O. L. Colee, Magnolia, Secretary.

Missouri State Dental Association, St. Louis, Jefferson Hotel, April 14-17. C. W. Digges, Exchange National Bank Bldg., Columbia, Secretary.

Montana State Dental Association, Butte, Finlen Hotel, May 2-4. F. E. Laing, 401 Hart-Albin Bldg., Billings, Secretary-Treasurer.

New Jersey State Dental Society, Atlantic City, May 21-24. J. Ward Weaver, 47 South Main St., Pleasantville, Convention Director.

North Carolina Dental Society, Pinehurst, Carolina Hotel, May 6-8. C. W. Sanders, Benson, Secretary-Treasurer.

Oklahoma State Dental Society, Tulsa, Mayo Hotel, March 31-April 3. Eugene Wise, Medical Arts Bldg., Tulsa, Secretary.

Pennsylvania State Dental Society, Pittsburgh, May 7-9. C. J. Hollister, 217 State St., Harrisburg, Executive Secretary.

South Carolina State Dental Association, Columbia, Wade Hampton Hotel, April 28-30. P. B. Hair, Spartanburg, Secretary-Treasurer.

Vermont State Dental Society, Burlington, May 22-23. F. A. Reid, Windsor, President.

Wisconsin State Dental Society, Milwaukee, March 25-27. Kenneth F. Crane, Bankers Bldg., Milwaukee 2, Secretary.

Meetings of State Boards of Dental Examiners

Connecticut Dental Commission, Hartford, March 19-23. C. G. Brooks, 302 State St., New London, Recorder.

Florida State Board of Dental Examiners, Jacksonville, April 8-11. A. W. Kellner, P.O. Box 155, Hollywood, Secretary.

Indiana State Board of Dental Examiners, Indianapolis, May 13-16 (dentistry and dental hygiene). Carl A. Frech, Gary National Bank Bldg., Gary, Secretary.

Iowa State Board of Dental Examiners, Iowa City, March 18-22. Harry G. Bolks, Badgerow Bldg., Sioux City, Secretary.

Kentucky State Board of Dental Examiners, Louisville, March 26-29. W. F. Walz, 1114 First National Bank Bldg., Lexington 3, Secretary-Treasurer.

Maine State Board of Dental Examiners, Augusta, State House, March 25-27, June 30-July 1. Carl W. Maxfield, 31 Central St., Bangor, Secretary.

Maryland State Board of Dental Examiners, Baltimore, March 11-13. Kyrle W. Preis, 700 Cathedral St., Baltimore 1, Secretary.

Massachusetts Board of Dental Examiners, Boston, March 18-20. John C. Wilson, 413 North State House, Boston, Secretary.

Nebraska Board of Dental Examiners, Omaha, Creighton College, March 20-23. C. A. Bumstead, Capitol Bldg., Lincoln, Secretary.

New Jersey State Board of Registration and Examination in Dentistry, Trenton, March 25-28. W. A. Wilson, 150 East State St., Trenton, Secretary.

North Carolina State Board of Dental Examiners, Raleigh, April 1. Wilbert Jackson, Rich Bldg., Clinton, Secretary.

Ohio State Dental Board, Cleveland, February 28-March 2 (practical), March 11-13 (practical), March 14-16 (theory). Earl D. Lowry, 79 East State St., Columbus 5, Secretary.

Oklahoma State Board of Governors of Registered Dentists, Oklahoma City, June 24-27. W. T. Longwell, First National Bank Bldg., Frederick, Secretary.

Pennsylvania State Dental Council and Examining Board, Philadelphia, March 4-9. Reuben E. V. Miller, 61 North Third Ave., Easton, Secretary.

South Carolina State Board of Dental Examiners, Columbia, March 28-30. C. Sparks, 1508 Washington St., Columbia 23, Secretary.

Tennessee State Board of Dental Examiners, Memphis, June 10-14. James J. Vaughn, 1005 Medical Arts Bldg., Nashville 3, Secretary.

Virginia State Board of Dental Examiners, Richmond, Medical College of Virginia, March 26. John M. Hughes, 715 Medical Arts Bldg., Richmond 19, Secretary-Treasurer.

West Virginia State Board of Dental Examiners, West Liberty, June 24-27. R. H. Davis, Clarksburg, Secretary.

Wisconsin State Board of Dental Examiners, Milwaukee, March 11-15 (dentists and hygienists). S. F. Donovan, Tomah, Secretary.

Other Meetings

American Association of Dental Schools, Kansas City, Mo., Continental Hotel, March 18-20. Carl O. Flagstad, 1549 Medical Arts Bldg., Minneapolis, Minn., Secretary.

American Society for the Advancement of General Anesthesia in Dentistry, New York City, Hotel New Yorker, March 25. M. Hillel Feldman, 730 Fifth Ave., New York 19, Secretary.

Dental Hygienists Association of the City of New York, New York City, Hotel Pennsylvania, April 5. Grace E. Clinchy, 67-134 Clyde St., Forest Hills 2A, Publicity Chairman.

Hermann M. Biggs Memorial Lecture, New York City, New York Academy of Medicine (Hosack Hall), April 4. Open to general public. E. H. L. Corwin, New York Academy of Medicine, New York, Executive Secretary.

New York Society of Orthodontists, New York City, March 4-5. Norman L. Hillyer, Professional Bldg., Hempstead, Secretary.

Thomas P. Hinman Mid-Winter Clinic, Atlanta, Ga., March 24-27. J. A. Broach, 1105 Doctors' Bldg., Atlanta, Chairman.

Internships, Externships, Residencies and Fellowships

Eastman Dental Dispensary, Rochester, N. Y. Director, Harvey J. Burkhart.

Joseph Samuels Dental Clinic of the Rhode Island Hospital, Providence, R. I. Director, Ernest A. Charbonnel.

Richmond Freeman Memorial Clinic for Infants and Children, Dallas, Texas. Executive Director, Dora B. Foster, 3617 Maple Ave., Dallas.

Walter G. Zoller Memorial Dental Clinic, University of Chicago. Address Director, Walter G. Zoller Memorial Dental Clinic, University of Chicago, Chicago 37.

Fellowships for Research and Graduate Work in the Dental Sciences, University of Rochester. Dean, George H. Whipple.

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